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The Federal Water-Power Policy

As noted at length elsewhere in this issue, the federal authorities have granted a permit for water-power development to the International Power & Manufacturing Company, which marks the second and perhaps most notable instance of the adoption of a progressive conservation policy by the government. The permit is unique in several important particulars, chief among which is the sliding scale of rates of compensation to be paid by the company. The provision that this rate shall vary directly as the square of the average price for electric energy and inversely as the square of the proportional development of the power site is clearly intended to promote the lowest reasonable rates for energy and the development of the broadest possible market. This is conservation of natural resources in the best sense, aiming at both use of the resources for the public benefit and profit to the promoters. The rates of compensation per horse-power developed, for low development and high energy rates, are high. That the company may be relieved of an obvious burden during the stages of construction and early operation, the payment of compensation is waived for the first ten years. This wise provision, coupled with the fact that the grant is an indeterminable permit, revocable only for cause or in case the public authorities take over the property at its fair and reasonable value, should assist materially in securing the necessary capital for the enterprise on favorable terms. It is also worth noting that the total yearly compensation will decrease as the rates for energy are reduced and as the proportion of full development of the site increases. The terms of the permit issued by the government undoubtedly measure closer to the leading features of recent public utility laws than any previous grant of such character. No value for the purposes of transfer to municipal, state or federal authorities, or for earning a return, may be put upon the permit, which ruling is in line with accepted views as to the value to be placed upon franchises under regulation. The indeterminate feature conforms with the Wisconsin public utility law and others more lately adopted. The same can be said in general of the provision for municipal, state or federal purchase of the property.

Protecting the Eyes of the Public

Work from which much good will result has been undertaken and partly completed by the (British) Illuminating Engineering Society in the study of school and library lighting with a view to formulating recommendations suitable for general adoption. Committees of this society, in co-operation with committees of the Association of Teachers in Technical Institutions and the Library Association, have issued preliminary reports on the artificial lighting of schools and libraries which call attention to several important features that should not be, but frequently are, overlooked. Prominent among these is the subject of glare. That glare is annoying to the reader and injurious to eyesight has long been appreciated, but only recently have attempts been made systematically to avoid glare in artificial lighting. Perhaps the half-formed belief that reduced lighting efficiency is inseparably associated with the avoidance of glare has played an important part in retarding the application of proper lighting methods in this connection. Investigations have confirmed the theory that less density of illumation is required for seeing when glare is absent than when it is present, so that even though the illuminometer shows less luminous-flux density, yet the eye is able to see more clearly when the lamps are hidden from view. A good motto for the designer of the lighting equipment of schools and libraries is "Safety first for the eyes." The fact that glare can be eliminated without extra cost points to the rapid introduction of proper illuminating methods in all places where even a small amount of attention is paid to the subject.

Co-operation with Real-Estate Dealers

The co-operation which has proved so wholesome between electric railways and real-estate men may well be extended to the central station. In some cities advantage is already being taken of the opportunities for mutually beneficial work in the development of new neighborhoods and the improvement of existing residential streets, but in other places the possibilities of close relations between the realty man and the distributor of electrical energy have received little recognition. There are two principal directions in which the real-estate business appeals to the commercial side of central-station work—first, as a long-hour user of energy for office and sign lighting, and second, as an influence on behalf of the most advanced practice in domestic applications, with special reference to a sufficient number of outlets, the maximum convenience of switch location and, in a word, the complete electrification of the home. Electric wiring is placed in almost every new building within the reach of central-station circuits, but too often the installation is stereotyped with too great a regard for first cost. Real-estate interests and achitects are coming into closer relations, and it is desirable that more attention be given to the location of floor and baseboard outlets, wall switches and the provision of circuits capable of carrying large currents for electric heating and cooking service. Where a large group of houses is built under the general supervision of a real-estate firm the central-station man can give far

better advice than the average architect as to the proper wiring installation for the discriminating purchaser or lessee. The returns from such co-operation are worth while to all parties concerned, insuring a larger ultimate use of electricity, raising the standards of the property from the real-estate viewpoint and helping to satisfy the resident of the house or apartment with his selection. A liberal policy toward the real-estate man is worth cultivating.

A Profitable Small Central Station

An income of over $6 per capita from a central station serving a rural community having 3500 inhabitants is rather exceptional, so much so that curiosity is aroused as to how the territory is developed to bring such results. Ordinarily a central station in such a town would have a precarious existence unless it were combined with some other industry or connected with an electric transmission system, and even at best it is seriously handicapped by high overhead charges and limited income. The problems of small central stations otherwise do not differ except in degree from those confronting large systems; but there is divided responsibility in the latter, together with an inherent striving for departmental efficiency at the expense of co-operation, while in the former close co-operation abounds and efficiency is lacking. If, therefore, the human efficiency as well as the plant efficiency is increased in small systems and the overhead charges are not too high, success, if it can be at all attained in the community, is sure to follow. This is in brief the secret of the showing made by the central station located at Walton, N. Y., and described elsewhere in this issue.

The manager of a small station must combine engineering discrimination with business ability, and he must be certain beforehand that any plan which he evolves will work and be successful, for he has no money to waste on experiments. In the rehabilitation of the Walton plant many engineering problems were involved. A change-over from 133 cycles to 60 cycles in a village which has primarily a lighting load and small prospects for a motor load is not ordinarily made so long as satisfactory single-phase motors for 133-cycle service are obtainable. However, the number of 133-cycle systems is constantly becoming smaller, which means that in a short while 133-cycle apparatus will be special and subject to higher prices and longer delivery dates. Moreover, within a reasonable time 60-cycle transmission systems will extend throughout the country and small generating stations will become substations for local distribution, so that the scrapping of 133-cycle equipment, even where many motors are in operation, is sound engineering and justifiable from an economic standpoint. The size of generating units is also a question well worth consideration in small stations. Because of a desire to have ample reserve equipment, two units of approximately the same size are ordinarily installed, with the result that in most cases a unit is operating at about one-tenth load two-thirds of the time. In the Walton plant a smaller unit is employed to carry the load during sixteen or twenty hours of the day with marked saving in steam.

That central stations in many small towns are not living up to their opportunities is shown by the small number of customers supplied by them. There is a prevailing impression that small-residence customers are unprofitable, and while in large cities with underground conduit systems the cost of running the service wires, including the meter, ranges from $50 to $80 and the income in many cases does not exceed $15 per annum, still in rural communities the cost of connecting a customer, including the meter, does not exceed $25 and oftentimes is not more than $15. Intensive development must obtain in a small community if the station is to be profitable, and this means that every house should be connected. To accomplish this requires a high-grade man, and unfortunately in most cases the income is not sufficient to permit the employment of such a man. It is curious to note what effect the tungsten lamp has had on the load curve of the Walton station and also what effect it would have had on the income curve if the company had not pushed the sale of appliances to offset the loss in energy consumption due to the use of a more efficient lamp.

The Heyland Commutator Machine

In many respects the alternating-current commutator motor is a more desirable machine than is its direct-current competitor. Its speed can be controlled by means of highly efficient stationary transformers instead of inefficient rheostats, while it can utilize energy obtained from a transmission system with the minimum of loss in conversion. In spite of these facts the machine has not been widely adopted for industrial service, largely by reason of its relatively high first cost, low efficiency and poor commutation. In the *Digest* in this issue appears an abstract of an article dealing with an alternating-current commutator machine said to be as economical in construction material and as efficient in operation as a direct-current motor designed for the same service. This motor has been developed and is described by Mr. A. Heyland, to whom credit is due for much pioneer work relating to the application of commutators to alternating-current machinery. In many respects the machine described by Mr. Heyland resembles simultaneously the Alexanderson repulsion-series motor outlined in our issue dated Jan. 18, 1908, and the Fynn unity-power-factor machine described in our issue of July 19, 1913. Use is made of the operating connections employed by Alexanderson, and the commutator remains short-circuited at all times along one axis in accordance with the method utilized by Fynn. In the latter respect the Heyland machine takes advantage of the operating features characteristic of the so-called Latour-Winter-Eichberg motor.

In view of the fact that the voltage across coils in electrical space quadrature to the short-circuited axis on the commutator must at all times have zero value, it will be appreciated that brushes placed on the commutator to cover these coils are always in neutral zones. It is evident, therefore, that these brushes can be dimensioned as though they were intended for use on a direct-current machine. To this fact are attributed certain of the desirable features of the new motor. In this connection sight must not be lost of the additional fact that when the conditions are as just described the machine is devoid of starting torque. In order to obtain torque at standstill resort must be had to other

connections which introduce all of the bad commutating conditions inherent in the single-phase motor of either the series or the repulsion type. One must make a choice between good commutation with zero starting torque and adequate starting torque with unsatisfactory commutation. In respect to the prominent outstanding starting difficulty with the alternating-current commutator motor the new machine seems to possess no advantage over standard types, and with reference to operating characteristics it seems to be merely on a par with the several improved types of motors recently developed in this country and abroad. To just what facts can be attributed its higher efficiency and smaller dimensions one is unable to determine from the data presented by the author. It is sincerely to be hoped that his claims can be substantiated in service performance and that he will continue his work of development, which promises well for the industry.

Indirect Car Lighting

The ordinary parlor or sleeping car has been a wonderful example of most of the things undesirable in artificial lighting. It has been most liberally provided with light obtained from small intense points located along the upper part of the car, striking the eye of the unoffending passenger in whatsoever direction he may turn. The result is a very noticeable amount of eye strain, and in spite of the brilliant illumination reading is by no means so easy as it should be. Not only does intense light contract the pupil abnormally and shut out light which would otherwise be useful, but owing to the motion of the car there is a constant effect of flickering as the images of the bright lamps shift upon the retina. Probably this effect is particularly responsible for the tired feeling that often comes over the eyes after a long train ride. The same trouble, lessened to a considerable extent, is too often noted in interurban and other electric cars. There are in this case a much smaller number of lamps, and these are in a less extended vista than in the case of the long cars of an express train, so that while the nature of the lighting may be just as troublesome, it is somewhat more easily dodged.

The indirect car-lighting fixtures recently introduced on express trains running out of New York are certainly admirable in effect, and reading under them is a pleasure. They consume a good deal more energy for equal illumination than do lamps used in direct lighting. On the other hand, we are very strongly inclined to the opinion that the indirect lighting will afford equal ease of seeing in the car without any increased expenditure of energy over that used in the glaring system which it replaces. We know of no place where from the general situation indirect lighting is more beautifully applicable than in cars where good direct lighting from the shape and dimensions of the space is particularly difficult to obtain. The scheme is certainly well worth trying on some of the more important interurban lines which operate practically under steam road conditions. Indirect fixtures are not subject to the breakage which checks the use of ordinary glassware and are quite simple to install and maintain. The chief requirement in their use is a suitable diffusing surface on the ceiling of the car, and the space between reflector and ceiling being relatively small, particular pains must be taken to get smooth and uniform diffusion. The texture as well as the color of the surface is all-important, a fact which is very noticeable in some of the cars in which indirect lighting is used. Here one notes at a glance the difference in the result produced by the tinting and texture of the car ceiling. These, however, are trivial matters, for a very little experience will show the best way of carrying out what is a most pleasing and commendable innovation in car lighting.

The Capacity of Single-Phase Lines

In all high-tension transmission systems the electrostatic capacity of the lines plays a prominent part, since the charging current of the system, containing a large reactive component, is proportional to this capacity. Rules and formulas are available for predetermining the capacity of uniform conducting lines in certain simple cases; but, in general, it is not possible to compute the capacity of a given geometrical distribution of conductors in two-dimensional space and the computation of the capacity of a given set of conductors in three-dimensional space is still further removed from our present mathematical abilities. Nevertheless, it is always possible to measure the capacity of any well-insulated set of conductors so that the present impossibility of computing such capacities need give no unhappiness to engineers. Moreover, estimates based on the judicious smoothing of contours can be made with a fair degree of precision to meet practical requirements. We merely have to admit that the general computation of electrostatic capacities, like the general computation of various other questions in the unsolved-problem locker of science, far transcends the powers of existing mathematics.

In the article by Messrs. C. A. Pierce and F. J. Adams appearing in this number are discussed two specific problems in the electrostatic capacity of two-dimensional uniform conductors, namely, that of two straight parallel cylindrical conductors in free space and that of two such conductors inclosed in a grounded metallic sheath. The solution of the former, or unsheathed, case is already well known, and has been published in a somewhat similar form in German textbooks for some years. A much simpler and more compact solution, using hyperbolic functions, has been worked out in this country by Dr. A. E. Kennelly and has appeared in our own columns, as in the number of Oct. 27, 1910. It has been shown, moreover, in our columns on Sept. 22, 1910, by Messrs. H. Pender and H. S. Osborne, that the surface density of the charge on each of such a pair of conductors may be represented by an ellipse, with one of its foci at the axis of the conductor.

The second, or sheathed, case is practically important because it represents the conditions encountered in many two-wire lead-covered cables, except that, in practice, the conductors are stranded instead of being strictly cylindrical. The article of Messrs. Pierce and Adams gives a useful reminder of the Maxwellian method of dealing with such a case. This method has been applied advantageously in three-conductor cables by changing the cross-sections of the conductors from the circular to the clover-leaf type.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Interstate Commerce Commission Requests Records of Telephone Operation

By the terms of an order issued on Aug. 8 by the Interstate Commission at Washington, all the common carrier telephone companies must furnish by Oct. 1 a detailed statement of their organization, equipment and physical and financial operations. This is the first order of the commission since the formal beginning of the telephone investigation. Already the inquiry has been very extensive, special agents of the commission having gathered an immense amount of data bearing upon the operation of telephone companies. As soon as practicable the commission will hold in various parts of the country public hearings, at which testimony will be taken as to the rates and operating methods of such companies as come within its jurisdiction.

Representative Men to Discuss Problems of the Industry

An invitation has been extended to about 200 men, consisting chiefly of the presidents of national, state and city electrical associations, societies and leagues, together with officials and representatives of the large electrical manufacturing companies, to attend a meeting at Association Island, Henderson Harbor, N. Y., Sept. 3 to 6. The meeting will be held under the auspices of the Association Island Corporation, and Mr. J. B. McCall, president of the National Electric Light Association, has been requested to preside. A tentative program has been arranged along broad lines, and it is expected that eminent men in various walks of life who have been invited to participate will attend. A meeting of high inspirational and educational value to the electrical fraternity is aimed at, with the hope that its character will be such as to justify a similar gathering each year, and that it will lead to an organization through which important work can be done for the industry.

Meeting of Executive Committee of N. E. L. A. Commercial Section

The executive committee of the Commercial Section of the National Electric Light Association met on Aug. 7 at Association Island, Henderson Harbor, N. Y. Mr. T. I. Jones, of Brooklyn, chairman of the section, presided, Mr. Douglass Burnett, of Baltimore, vice-chairman, and Mr. Joseph F. Becker, of New York, secretary, together with eleven other members of the committee being present. A number of standing committees were appointed, the personnel of which will be announced at the October meeting, to be held in New York City. Mr. E. L. Callahan of Chicago, was appointed chairman of the finance committee, and Mr. Douglass Burnett, of Baltimore, vice-chairman. Mr. Burnett was also appointed chairman of the publication committee, and Mr. E. H. Edkins, of Chicago, vice-chairman and sales manager. The membership committee is headed by Mr. J. F. Becker, of New York, and Mr. D. L. Gaskill, of Greenville, Ohio, is vice-chairman.

It was decided to revise the "Solicitor's Handbook," which has been turned over to the Commercial Section by the association, and to publish it free in connection with data on electric light and motor installations heretofore included in the "Digest." It was also decided to keep down the number of papers to be read at the next convention so as to permit more time for discussion. The papers themselves will be devoted to topics of national importance, interesting alike to small and large companies. A new constitution was presented for consideration, and the term of each member of the executive committee was fixed at three years, six members completing their term of service each year. The next meeting of the committee will be held in New York City during the Electrical Show.

Public Service Company of New Jersey Appeals Utility Commission Decision

The Public Service Gas Company, of Newark, N. J., carried to the Court of Errors and Appeals at Trenton on July 31 an appeal from the decision of the Supreme Court of New Jersey sustaining the order under which the Public Utility Commission forced the company to furnish 90-cent gas in fifteen municipalities constituting the Passaic zone. The company contends that the order is unjust and unreasonable and unconstitutional, because its effect is to take property without just compensation. Other grounds advanced for reversal are that the valuation of $4,750,000 placed upon the property by the board was below the fair value of the property; that in estimating the reproduction cost the board disregarded reliable and uncontradicted proof of value and accepted unreliable and inaccurate evidence; that the board excluded important elements of value, including special franchises, bonds and stocks representing the cost and the market value of securities, and that the findings were inadequate because the board included only fifteen of the 150 municipalities in which the company operates in the State.

A. I. E. E. Affairs

At the first meeting of the directors of the American Institute of Electrical Engineers for the new administrative year, held in New York on Aug. 8, President C. O. Mailloux announced the appointment of most of the Institute committees for the year. The chairmen of the standing committees thus far appointed are as follows:

Finance, Mr. J. Franklin Stevens, Philadelphia, Pa.; library, Dr. Samuel Sheldon, Brooklyn, N. Y.; meetings and papers, Mr. W. S. Rugg, New York; editing, Mr. Lewis T. Robinson, Schenectady, N. Y.; board of examiners, Mr. Maurice Coster, New York; sections, Mr. Paul M. Lincoln, Pittsburgh, Pa.; standards, Dr. A. E. Kennelly, Harvard University; code, Mr. Farley Osgood, Newark, N. J.; law, Mr. Charles A. Terry, New York; patent, Mr. Ralph D. Mershon, New York; educational, Prof. Henry H. Norris, Ithaca, N. Y.; electric power, Mr. David B. Rushmore, Schenectady, N. Y.; telegraphy and telephony, Mr. F. F. Fowle, New York; electrochemical, Prof. Albert F. Ganz, Hoboken, N. J.; electrophysics, Dr. J. B. Whitehead, Baltimore, Md.; use of electricity in mines, Mr. Wilfred Sykes, Pittsburgh, Pa.; use of electricity in marine work, Lieut. C. S. McDowell, U. S. N., Brooklyn, N. Y.;

public policy, Mr. Calvert Townley, New York; historical museum, Mr. T. C. Martin, New York; United States national committee of International Electrotechnical Commission, Prof. Francis B. Crocker, New York; code of prinicples of professional conduct, Prof. George F. Sever, New York; relations of consulting engineers, Mr. Lewis B. Stillwell, New York; membership, Mr. A. M. Schoen, Atlanta, Ga.; constitutional revision, Mr. Bancroft Gherardi, New York.

The board elected from its own membership the following three members to serve upon the Edison medal committee for two years in place of members on the committee whose terms had expired: Messrs. H. H. Barnes, Jr., William McClellan and S. D. Sprong. Mr. Ralph D. Mershon was also elected a member of the committee for the term of one year to fill a vacancy. The board also confirmed the appointment by the president of Mr. J. Franklin Stevens and Mr. H. W. Buck as members of the Edison medal committee for the term of five years.

The following local honorary secretaries, whose terms expired on July 31, 1913, were reappointed for the two years ending July 31, 1915: Mr. Clare F. Beames, for India; Mr. Richard O. Heinrich, for Germany. Mr. Guido Semenza was appointed local honorary secretary for Italy for the same period.

Electrical Men in Automobile Accident

As the result of an automobile accident near Wyandotte, Mich., on the evening of Aug. 10, Messrs. Louis E. Beilstein, until recently general manager of the Toledo (Ohio) Railways & Light Company; James T. Ross, consulting engineer of the Northern Ohio Traction & Light Company of Akron, Ohio, and the Lake Shore Electric Railway of Cleveland, Ohio, and the chauffeur lost their lives, and Mr. J. F. Collins, vice-president and general manager of the Michigan Traction Company of Jackson, Mich., and Mr. Edward T. Wickwire, sales manager of the Ohio Brass Company, Mansfield, Ohio, were seriously injured. A ditch was encountered on the outskirts of Wyandotte, and in an attempt to turn the machine out the right front wheel collapsed and the automobile turned over. The plans for the trip from Toledo to Jackson, Mich., were made in the office of the Lake Shore Electric Railway at Cleveland and Mr. Charles Currie, general manager of the Northern Ohio Traction & Light Company, accompanied the party to Toledo by train, but returned home when they started on the auto trip. On Aug. 13 hopes were entertained for the recovery of both the injured men.

New Hampshire Hydroelectric Situation

The controversy between the federal government and the State of New Hampshire, which was precipitated by the action of Attorney General Tuttle of New Hampshire in blocking the purchase of forest reserve lands under the Weeks act, has taken a new turn at Washington in view of prospective hydroelectric developments in Grafton County by the Central New Hampshire Power Company. A portion of the reserve is situated in this section of New Hampshire, and under the terms proposed by Mr. Tuttle the federal government is required to surrender to the State not only the title of all public waters but in addition the right of access thereto, together with the right to grant any public franchise upon the reserve. The Central New Hampshire Power Company, incorporated under the laws of the State of Maine, has recently made plans for developing 80,000 hp to be utilized at various points in Grafton, Sullivan and Merrimac Counties. The first development will be at Croydon Brook, and the company estimates that the gross yearly income from this project alone will be $81,000, while the revenue from all the developments in which the company is interested, aside from possible developments in the federal reserve, is $3,000,000. According to data on file with the Bureau of Corporations, the State of New Hampshire imposes no tax upon water-power development, and the federal authorities are reported to be up in arms lest the resources now running to waste on the proposed Appalachian reserve be developed by the Central New Hampshire Power Company acting under the authority of the New Hampshire State officials, who have manifested every desire to encourage hydroelectric development within the borders of the commonwealth.

Mr. Ernest Freeman on Contractors and the Society for Electrical Development

In the following paragraphs are given arguments by President Freeman of the National Electrical Contractors' Association relating to the benefits to be derived from co-operation under the auspices of the Society for Electrical Development.

Electrical contractors believe that the work of the society will be of direct benefit to the industry and to contractors individually, and that the direct individual profit will be very much in excess of the relatively small proportionate share subscribed to the movement. This result will follow, not only from the national advertising, but also from the publicity work in newspapers, magazines, moving pictures, electric-sign exchanges and numerous other means.

One of the announced purposes of the society is to bring about co-operation for promoting harmonious local relationship. Harmony is a distinctly practical business proposition, not only to contractors but to the central station, the jobber and the manufacturer, who make up the industry in which all are doing a distinctly related business.

"Related," we say, but there are cases where the relations are strained—strained to a point where it is the belief of all that the sale of sockets, wire, conduit, lamps, motors, fans, irons and all classes of supplies and appliances and of electric energy is being actually hindered. The friction between the various interests engaged results in immense loss to us all, and this friction is chiefly caused by lack of understanding of each other, and perhaps lack of sagacity in merchandising.

It seems logical to believe that the more live people or concerns there are pushing electrical goods, the more electrical business will be done. It is well known that in the cities where there is harmony the constructive development of the industry is at its greatest, to the mutual profit of all concerned.

Considerable time will be required to harmonize local conditions, and much money will be required. The time required can well be devoted to it and the money needed can well be spent in this way. The carefully graded subscriptions by which the funds are created for the various kinds of work are a very small proportion of what it will mean to accomplish the purposes of what is probably the greatest and most far-sighted mutual co-operative movement that has ever been started in any known industry.

Display Lighting at Fall River, Mass.

What was probably the greatest civic celebration in the history of the city marked the opening of the new "White Way" in Fall River, Mass., on Aug. 6. The new lighting system, consisting of an original installation of ninety-six 6.6-amp inverted magnetite arc lamps, with more to follow, was installed by the Fall River Electric Light Company as the result of a vigorous campaign conducted by the merchants' association. The ceremonies included a banquet attended by 300 guests, speeches by the Mayor and other leading citizens, a parade and other features such as go to

make up a carnival night. The banquet hall was illuminated by about 150 miniature lamps, modeling the type used on the streets. The service will be furnished by the Fall River Electric Light Company at a price of 30 cents per night for lamps burning from dusk to dawn and at 24 cents each per night for lamps burning from dusk to midnight. The local merchants' association secured subscriptions totaling $12,000 toward the expense of installation, and the association and the city share the operating cost, the former paying one-third and the latter two-thirds of the expense. It was pointed out at the banquet that the cost of ornamental display lighting will not increase taxation over 5 cents per $1,000. During the present month the company will supply electricity free to the display installation. The New Bedford (Mass.) City Council lighting committee attended the opening of the Fall River service and was sufficiently impressed to decide upon an early increase in the street-lighting installation of the former city.

Leonard Patent for Electric Control

There has been issued to Mr. H. Ward Leonard an unusually broad and comprehensive patent for an electric-current controller, which is of more than passing interest. The application had been pending in the Patent Office for nearly nine years, having been filed on Dec. 12, 1904. Generally speaking, the invention, described in Patent No. 1,064,749, June 17, 1913, consists of a system of electromagnetic contactors for automatically cutting out starting

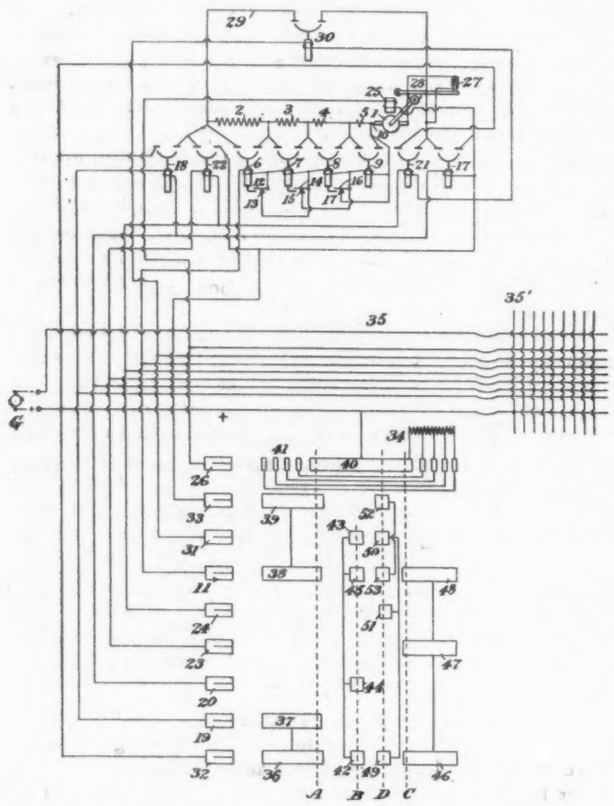


FIG. 1—CONTROL OF SHUNT-WOUND MOTOR

resistances in a motor circuit and means for utilizing the same contactors and resistances in automatic electrodynamic braking, one of the interesting features being the application to multiple-unit control of electric trains.

The preamble of the specification states that the invention relates to the control of the current through a device by means of the electromotive force upon the terminals of the device, or upon the terminals of a device functionally related thereto. An instance of its application is the control of the current through a motor armature by means of the electromotive force upon the armature terminals. The principal object is to control the current through the device so that the current will be automatically maintained within such limits as are required for the desired operation.

Among the useful applications of the fundamental principles named are electric motors, storage batteries, electromagnets, electric furnaces and other forms of electroheating devices, rheostats, electric lamps and electric signaling devices.

Fig. 1 illustrates the invention as applied to the control of a constant-potential shunt-wound motor. The motor armature is shown at 1, the field circuit at 25, the starting resistors at 2, 3, 4 and 5, and the corresponding contactors 6, 7, 8 and 9 just below the latter. A mechanical brake on the motor shaft is shown at 28, which is released when armature current flows through the solenoid 27. The controller is shown at the lower part of the figure, the energy source being *G*, and the group of conductors 35 extending away to the right representing connections to multiple units similar to the one shown. The several positions of the controller are as follows: *A* is the forward-running position; *B* is the electrodynamic-braking position for stopping in the forward direction; *C* is the reverse-running position, and *D* is the corresponding braking position.

Upon passing from the "off" postion to *A*, the field circuit is closed through contact 40 and finger 26; contacts 36 and 37 and fingers 32 and 19 operate contactors 17 and 18 and close the line circuit through the armature and the entire starting resistor, while contacts 38 and 39 and fingers 11 and 33 connect the contactors 6, 7, 8 and 9 in series across the motor brushes, but contactor 6 has a switch short-circuiting 7, and 7 in the same way short-circuits 8, etc., so that 6 only is in circuit at the start.

As the armature speed increases so does the counter emf and the current in 6, and presently there is sufficient current in the latter to close it and cut out resistor 2. This also throws contactor 7 in series with 6 and again presently the operation is repeated, as the counter emf keeps rising with the speed, and resistor 3 is cut out. And so on, 8 and 9 operate in succession, and finally all resistance is cut out and the motor is at full speed. Further speed increase can be obtained by hand control by cutting the resistors 34 in series with the motor field, upon slight movement of the controller handle.

Passing to position *B*, to apply braking, all contactors are opened and released; then 17 is reclosed by means of contact 44 and finger 20, while 6, 7, 8 and 9 are connected in series with the motor armature across the supply mains by means of contact 45 and finger 11, and the braking contactor 30 is closed by 43 and 31 at the controller, thus closing the motor armature circuit through the starting resistors 2, 3, 4 and 5. The difference between the counter emf of the motor armature and the emf of the supply circuit, which oppose each other, increases as the motor speed decreases; thus the contactors act as before and successively cut out resistance until, at rest, the armature is short-circuited.

In postion *C* the whole operation is quite similar, except that contactors 21 and 22 are closed instead of 17 and 18, thus reversing the armature current. Among the advantages claimed are acceleration and retardation with nearly constant torque, contributing greatly to the comfort of passengers and materially reducing the strain and wear on the mechanism. An arrangement of contactors generally similar, but securing reverse of rotation by reversing the field connections, was also shown and as a whole appears less complicated. Many applications of the invention were discussed in the specification, and one in particular, a motor-driven planer with slow-cutting stroke and fast bed return, was illustrated.

Fig. 2 illustrates an arrangement in which a single

solenoid can be used to control automatically the resistance in the armature circuit during starting. Successive lifts of the plunger, each against an increased weight or washer, take place as the counter emf rises and increases the suction of the solenoid, cutting out successive resistance steps.

The patent contains in all sixty-four claims. Some of those which seem especially significant are given herewith:

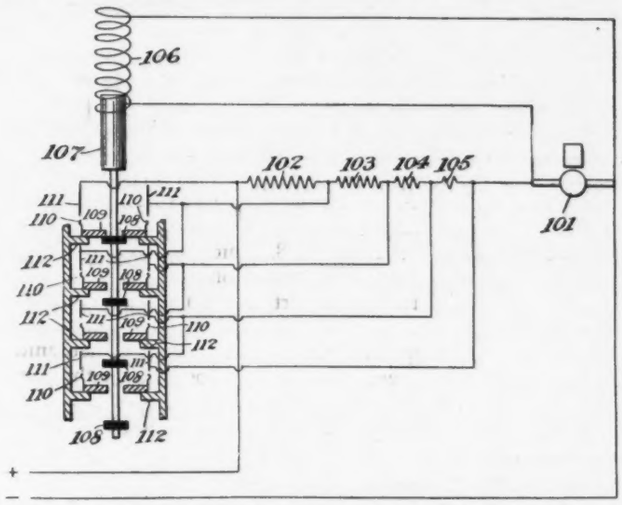


FIG. 2—RESISTANCE CONTROL OF ARMATURE CURRENT

"2. The combination of an electric motor and means for automatically accelerating and retarding the motor, said means comprising one or more automatic switches closed by the counter emf of the motor, the same switch contacts being employed and closed for controlling both acceleration and retardation of the motor.

"5. The combination of an electric motor, means controlled by the counter emf of the motor for automatically accelerating the motor and for automatically retarding the motor controlled by the difference between the source of emf and the counter emf of the motor.

"24. The combination of an electric motor, a rheostat in circuit therewith, means responsive to the electrical condition of the motor armature for automatically reducing the resistance of said rheostat to accelerate said motor, and means for causing the motor armature to generate a braking current through said resistance and for cutting out at least a part of said resistance.

"26. The combination of a plurality of electric motors, a starting rheostat for each of said motors, means for simultaneously connecting the motors with the supply circuit, and independent automatic means corresponding to each motor for automatically accelerating and retarding the motors, said means for retarding comprising an element magnetically moved to increase the retardation.

"45. The combination of a dynamo electric machine having a field winding energized independently of its armature current, an energy absorbing means in series with the armature of said machine, and automatic controlling means for causing said absorbing means automatically to control the armature while the armature is absorbing energy and for causing said absorbing means automatically to control the energy and retard the armature while the armature is generating energy, said automatically controlling means comprising a plurality of windings selectively responsive to changes in the electrical condition in the motor armature circuit.

"54. A multiple-unit control system, comprising a plurality of units, means for automatically electrically accelerating and automatically electrically retarding said units, and a plurality of means under the control of the operator and corresponding to different units for controlling said first-named means."

Canada's Largest Generating Station

Work is at present under way on a hydroelectric station on the St. Lawrence River which when completed will be the largest in the Dominion of Canada. Its initial rating will be 100,000 hp, and later on this will be increased to 160,000 hp. The site is at Cedar Rapids, about 30 miles above Montreal, and the work is being pursued by the Cedar Rapids Manufacturing & Power Company. The property was taken over January, 1912, by the financial interests with which the Shawinigan Water & Power Company and the Montreal Light, Heat & Power Company are allied. Up to that time it was controlled by Mr. D. Lorne McGibbon, who remains as one of the directors of the company at present, and the engineering work had been under the charge of Mr. Henry Holgate, the well-known consulting engineer of Montreal. With the transfer of the property the personnel of the company changed as follows: President, Mr. J. E. Aldred; vice-president, Mr. Howard Murray; secretary-treasurer, Mr. J. S. Norris; electrical engineer, Mr. R. M. Wilson, and hydraulic engineer, Mr. Julian C. Smith.

Shortly afterward the question of the design and construction was actively taken up and an effort made to let the work by contract. At that time comparatively little was known regarding the conditions of the ground, and particularly as to what would be encountered after the unwatering work was completed. Because of these uncertainties it was decided that the company itself should undertake the preliminary work, and accordingly a construction force was organized and the cofferdams were built. There is about 15,000 ft. of cofferdam in connection with the work, and the cofferdams were practically completed in June, 1912. As soon as the site was unwatered Messrs. Fraser, Brace & Company received the contract for the steam-shovel excavation and concrete work in connection with the power-house substructure. A contract was made with the Unity Construction Company for the superstructure, and it is believed that this is the first time that a large power station is to be built by the unit method. The building will be a special reinforced-concrete structure with steel sashes and metal doors. The general design is in many ways similar to that of the hydroelectric station at Keokuk, with the exception of the canal, which extends above the power house for a distance of about 10,000 ft.

There are three rapids in the St. Lawrence River between Lake St. Francis and Lake St. Louis. Beginning at the upper end, these are the Coteau Rapids, Cedar Rapids and Cascade Rapids. On both sides of the St. Lawrence River are also canals built by the Dominion government. On the south side is the Beauharnois Canal, which is to a large extent abandoned for navigation purposes, but which is now in use by the Canadian Light & Power Company in connection with its development at St. Timothée. On the north side of the river is the Soulanges Canal, through which all shipping passes from the Great Lakes to Montreal. The three rapids mentioned are rather long slopes in the river, and the steamers of the Richelieu & Ontario Navigation Company run the rapids as part of their trip from the Thousand Islands to Montreal.

The Cedar Rapids development utilizes the fall of the Cedar Rapids by the construction of a canal along the north shore of the St. Lawrence River and by the erection of a power house which will form the dam at the lower end of this canal. The canal is built immediately on the old shore line of the river and utilizes this shore line as part of one bank. The south bank is formed by an artificial earth dike about 10,000 ft. long. The head on the waterwheels will be approximately31 ft., and owing to the very stable water levels of the St. Lawrence River this head will be almost constant, as the level of the water above and below the development only varies about 3 ft. as an extreme. The Cedar Rapids Manufacturing & Power Company has a lease from the

Dominion and provincial governments for the utilization of sufficient water to develop 160,000 hp continuously for this head. Contracts have been made with the I. P. Morris Company, of Philadelphia, for nine 10,800-hp vertical waterwheels and with the Wellman-Seaver-Morgan Company of Cleveland for three units of the same kind. An interesting feature in connection with the design of the turbines is the arrangement for carrying the weight of the generator rotor and the moving parts of the turbine on a thrust-bearing above the generator instead of below it as is often done. The weight of the generator will be taken by cast-iron supporting barrels through the turbine to the foundation below. The main units will be of the single-runner, vertical-shaft type and will be installed in the concrete foundations of the power house. The intakes will be of the scroll or involute type, and the waterwheels will probably be the largest in bulk ever made.

All of the governors, governor pumps and exciter wheels and the various appurtenances for the waterwheels have been purchased from the I. P. Morris Company. A contract has also been made with the Canadian General Electric Company for twelve 10,000-kva, 6600-volt, 60-cycle, three-phase alternators operating at 55 r.p.m. The exciters, exciter motor-generator sets and various other apparatus used in connection with the generators and exciters have also been purchased from the Canadian General Electric Company. The work in the field was well advanced, and it is expected that water will be let into the completed canal in the fall of 1914 and that shortly thereafter delivery of electrical energy will commence. Contracts have been made with the Aluminum Company of America and with the Montreal Light, Heat & Power Company for large amounts of energy, so that the income of the company is assured. The company is very strongly financed, being controlled jointly by the Shawinigan Water & Power Company and the Montreal Light, Heat & Power Company and having interested in its development various other financial interests allied with the two corporations. The initial bond issue was taken up by shareholders of both the Shawinigan Water & Power Company and the Montreal Light, Heat & Power Company.

Electric Vehicles for Meat Delivery

At the annual convention of the United Master Butchers of America, held this week in Boston, a paper on "The Economical Delivery of Meats and Provisions" was presented at the request of the organization by Mr. Day Baker, New England manager of the General Vehicle Company and president of the Electric Motor Car Club of Boston. The author emphasized the rising cost of horse transportation and its inadequacy in the face of modern demands for rapid and extended deliveries, and pointed out the economic waste resulting from the non-productive acreage required in raising feed for animals. Analyzing the space requirements of a given capacity in horse-drawn and electric truck equipment, Mr. Baker stated that for carrying 5 tons of meat over 30-mile routes two horse-drawn trucks would require 240 sq. ft. of storage area; stalls for four to six horses, 160 sq. ft.; harness room, 60 sq. ft.; hay, grain, bedding storage, 120 sq. ft.; manure storage, 30 sq. ft., or a total of 610 sq. ft., compared with only 160 sq. ft. for a 5-ton electric truck to do the same amount of work. The saving in area at $1 per sq. ft. per year, the New York price, would be $450 in favor of electric service.

Comparing operating expenses, the per diem cost of service on a 5-ton, 30-mile basis would be as follows: Horse service, space value, $2 per day; feed, $5; drivers' wages, $6; total, $13. With the 5-ton electric truck, the space value would be 50 cents per day; cost of electrical energy, $1; drivers, $3; total, $4.50. Taking all costs into account, including fixed charges, the speaker said that two 5-ton horse-drawn trucks cannot be operated for less than $15 per day, while a 5-ton electric truck can be run for an over-all expense of from $8 to $11 per day. With horse traction all expenses tend to increase as time goes on, while with the electric truck the price of all large items such as electricity, batteries and tires is decreasing. Electricity has fallen in price from 10 cents to from 4 cents to 1.5 cents per kw-hr. in the larger cities. Tires can now be guaranteed for 10,000 miles' service, or eighteen months' life.

In conclusion, the speaker exhibited a large number of lantern slides showing applications of the electric truck in packing and provision-house service, pointing out that the first motor truck used in carrying meats was operated six years ago by Schwarzschild & Sulzberger at Norfolk, Va., during the Jamestown Exposition. This machine is in service in New York to-day, its long life being due to its being an electric truck without fast vibratory engine, change of gears or running at excessive speeds. The growing popularity of the electric truck in this field is shown by the fact that twenty-seven of the prominent packers and dealers of the country are using ninety-five machines of a single make, aggregating 260 tons in carrying capacity and ranging in size from the 1000-lb. wagon to the 5-ton truck. The United Dressed Beef Company of New York operates twenty-three trucks, of which nineteen are rated at 3½ tons each. Sulzberger & Sons Company, New York, operates eleven trucks of 3½ tons rating, and the smaller dealers are taking up the question of electric transportation in many parts of the country and are obtaining striking economies from their first equipment.

Long Acre Electric Light & Power Company Wins Decision

Justice Greenbaum announced on Aug. 11 in the Supreme Court that he would dismiss the foreclosure suit brought by the Edison Electric Illuminating Company of New York City against the Long Acre Electric Light & Power Company through the Metropolitan Trust Company, as trustee, on condition that the $90,000 interest which has been accumulating since 1906 was tendered to the bondholders at once. The interest money was offered to the bondholders on the trial of the foreclosure suit, and as the Long Acre company still has the backing of the banking firms of A. B. Leach & Company and Harvey Fisk & Sons the interest doubtless will be paid.

The foreclosure suit followed a previous action brought to prove the Long Acre company's charter invalid. The courts denied this contention and the Public Service Commission of the First District granted the company permission to issue $4,000,000 in bonds and $2,000,000 new capital stock to build up its plant.

The Long Acre company issued $500,000 in bonds in 1906 when its claims to a valid electric lighting franchise in Manhattan were not taken seriously. A block of $185,000 of these bonds fell into the hands of the late William H. Kelly, at one time judge of the City Court, who named Mr. Charles F. Murphy as one of the executors of his estate. Mr. Murphy, it is claimed, sold the bonds to the president of the New York Edison Company.

In his opinion Justice Greenbaum said the nominal buyer of the bonds was the Central Trust Company, but the money was furnished by the Edison company. The trust company bought up over $400,000 of the bonds and then called on the Metropolitan Trust Company as trustee to foreclose on the mortgage, asserting the right to demand payment of the principal at once because of default of interest since 1907.

The Long Acre company contended that the bonds were invalid because it had failed to get the permission of the Public Service Commission before it issued them. Justice Greenbaum overruled this defence and said that more serious and interesting issues were whether the Central Trust

Company, which bought the bonds with money furnished by the Edison company, was an "owner and holder" with power to declare the principal payable before the date fixed in the mortgage, and whether there had been a default in the payment of the interest.

Justice Greenbaum said that even if he was wrong in his ruling that the trust company was not the real owner of the bonds, the plaintiff failed to show by evidence of a satisfactory character that a demand for the payment of the interest was ever made. The court ruled that the Long Acre company might renew its offer made on the trial to pay the $90,000 interest due up to the date of the trial, and if the plaintiff refused to accept the interest the money might be paid into court.

Increase in Electric-Truck Registrations in Massachusetts

In a recent interview at Boston, Vice-president E. S. Mansfield of the Electric Motor Car Club of that city stated that the registration of electric trucks in Massachusetts for the seven months ended July 26 shows a gain of 92 per cent over the number of machines of this type in the State a year ago. Mr. Mansfield pointed out that the electric-truck industry has reached a development competent on a small scale to duplicate practically every other form of land transportation service.

Recent sales of electric vehicles at Boston include a 5-ton General Vehicle ice wagon for the Central Manufacturing Company to operate on a schedule of about 35 miles per day between the Dorchester section and the wholesale market district. The savings in leaks resulting from the increased schedule speed of the motor-driven ice cart as compared with the time-honored horse-drawn wagon was an important factor in securing the adoption of electricity. The Edison Electric Illuminating Company of Boston has added six General Vehicle 2-ton electric trucks with winch equipment to its fleet, and these units are provided with extra large batteries in order to facilitate rapid and heavy work in line construction and maintenance on hilly roads and streets in the suburban districts. The company now operates a total of forty-two electric vehicles. Electric trucks are becoming more popular in the Boston coal trade and suburban dealers are beginning to purchase this equipment.

In the central-station field, the New Bedford (Mass.) Gas & Edison Light Company now operates some eight machines. General Manager W. H. Snow, with the assistance of Mr. Daniel W. Beaman, of this company, will present a paper on "The Value of the Electric Vehicle to the Central Station" at the Burlington (Vt.) convention of the New England Section of the National Electric Light Association on Sept. 17-19. President Day Baker of the Electric Motor Car Club of Boston accepted an invitation of the Master Butchers of America to deliver an illustrated lecture on "The Transportation of Meat and Provisions" at the twenty-eighth annual convention of that organization in Boston on Aug. 12. On July 16 the Electric Motor Car Club held an outing at the New England Kennel Club, Braintree, Mass., as the guests of President Edgar of the Boston Edison company, so that on neither the social nor the business side was there any midsummer dullness.

Public Service Commission News

MARYLAND COMMISSION

The Maryland Public Service Commission has received a complaint from Mr. George A. Whiting, who said that the Consolidated Gas, Electric Light & Power Company drew up plans for wiring his company's plant and furnished two experts to supervise and approve the work last fall. For six or eight months the bill for energy averaged about $500. Then it was discovered that the wires were grounded and that a large quantity of energy was being wasted. The central station remedied the trouble and the monthly bill for energy dropped to $256. Mr. Whiting now asks the commission to compel the company to revise its previous bills on the basis of tonnage turned out at the plant. Mr. Whiting's complaint will be referred to William Cabell Bruce, general ccounsel for the commission.

NEW YORK COMMISSIONS

The Public Service Commission of the First District has ordered the United Electric Light & Power Company to cancel by Oct. 1 three "riders" now in force in its standard contracts. Action of the commission was taken upon the recommendation of Commissioner Maltbie, who held hearings on the complaint of Alonzo B. Knight, who owns two buildings, each containing residents' apartments as well as stores. The company's rate to small consumers is 10 cents per kw-hr. One "rider" covered "tenants' consumption-wholesale rate," and the complainant wanted to take advantage of this rate whereby he might get the entire energy of the two buildings charged to him at 5 cents per kw-hr. or less, he collecting from the tenants at the full rate of 10 cents. Commissioner Maltbie held that the riders objected to are discriminatory.

The New York Edison Company and the Astoria Light, Heat & Power Company have made application to the Public Service Commission for the First District for permission to issue additional securities. The New York Edison Company asks for permission to issue $15,800,000 in capital stock in addition to $50,153,400 already issued. The proceeds of the new stock are to be used to pay off notes given to the Consolidated Gas Company for money used on the plant and property of the Edison company. The Astoria Light, Heat & Power Company asks for permission to issue $5,000,000 in first mortgage 5½ per cent bonds and also $9,500,000 capital stock in addition to $500,000 capital stock already outstanding. The proceeds of the proposed stock and bonds are to be applied to the refunding of $14,125,000 in notes of the company held by the Consolidated Gas Company and for the retirement of $375,000 outstanding as mortgage bonds.

Current News Notes

EMPLOYEES' SAVING FUND IN CHICAGO.—A statement issued on July 1, 1913, showed that of the 2756 employees of the Commonwealth Edison Company eligible for the employees' saving fund, 2126, or 77 per cent, have availed themselves of the opportunity presented.

* * *

WIRELESS IN CANAL ZONE.—Construction work has begun on the large radio station at Caimito, Canal Zone. This will be one of the most powerful wireless stations in the world and will be similar to the great station at Arlington. It will embrace three towers, each of which will be 600 ft. high, which will be arranged in the form of a triangle with sides 900 ft. long. Nominal radius for the sending and receiving machinery will be 3000 miles, which will enable it to keep in communication with Washington.

* * *

UNIVERSITY OF ILLINOIS.—The building program of the University of Illinois for 1913-14 calls for an expenditure of $1,400,000, including $250,000 for a chemical laboratory, $100,000 for an engineering hall and $45,000 for a boiler house. Mr. John I. Parcel, of the University of Minnesota, has been appointed professor of structural engineering, and Mr. George B. Rice, of the Treasury Department at Washington, has been named as lecturer on the installation and operation of mechanical equipment.

Telephone Controversy in Louisville.—The Cumberland Telephone & Telegraph Company (Bell) has submitted terms for a compromise in the litigation in which the city and the company have been involved since 1909. It offers to refund $137,000 collected since 1909 in excess of ordinance rates; to give the "metropolitan" zone service rather than the restricted city service; to dismiss all suits against the city now pending, and to erect a million-dollar office building in the business district. In return it asks that the Grinstead rate ordinance be amended to permit the charging of these rates: Business, direct line, $72; business, two-party line, $51; residence, direct line, $36; residence, two-party line, $27. These rates are somewhat higher than those fixed in the Grinstead ordinance, which apply, however, to the city only.

* * *

Annual Report of Department of Electricity of Chicago.—For the calendar year 1912 the expenses of the department of electricity of the city of Chicago amounted to $1,400,239, as shown in the annual report of Mr. Ray Palmer, the city electrician. The revenue earned by the department for the year was $251,671, the largest item being fees for electrical inspection, which amounted to $163,340. It is of interest to note the cost of electrical inspection was $74,812, so that this bureau of the city government is one that returns a satisfactory profit. The city electrician recommends that the revenue from the electrical inspection shall be expended only for the purpose of electrical inspection work; otherwise the balance of the inspection fees becomes a tax on the users of electrical energy. The number of officers and employees in the whole department was 442.

* * *

A Faulty Detail of Hat Construction.—Very frequently persons who are following dangerous vocations are careful that their apparel shall in no wise increase the risk they are taking. Yet many men engaged in handling high-tension wires wear what is commonly known as a black stiff hat, not having observed that there is an electrical conductor embedded in the rim of the hat. A fatal accident resulting from this type of hat has rather forcibly called attention to the fact that each hat of this kind is made with a steel wire as the reinforcing element of the rim. A substation foreman on an electric line in northern Indiana was explaining details of some work to his men in a recently completed substation. In pointing out a joint in the high-tension wiring, hat in hand, the rim of the hat came into contact with the wiring. The circuit was completed from the high-tension line through the small steel wire and the man's body to the ground thereby causing a shock which proved fatal. In view of the above accident it might be well for men in the electrical industry to specify hats with non-conducting reinforcement in their future purchases.

* * *

Standardization Work of the Electric Vehicle Association of America.—The standardization committee of the Electric Vehicle Association has under consideration at the present time a proposed charging plug of larger size which will take care of the heavier commercial vehicles. An attempt is also being made to adopt a standard list of lamp bulbs, in order to reduce the number now in use because of small variations in voltage ratings and deviations in bulb shapes. The committee is going to take up the question of a standard method of testing the rating of solid tires for efficiency. Because of the wide variation in compounds used and of the effect this has on both speed and mileage of electric vehicles, this is a very important question. The standards which have been adopted and which are proposed should result in improving the electric vehicle as a whole and should bring more uniform practice in regard to the various attachments and equipment. These can just as well be standard as any others, without at all limiting the several manufacturers in carrying out their individual ideas. It is thought that the work already done along the line of standardization, as well as that planned for the future, will result to the decided advantage of all concerned, including the vehicle manufacturer, the owner, the garage and the central station.

* * *

SOCIETY MEETINGS

Vermont Electrical Association.—The Vermont Electrical Association will hold its annual convention at Burlington on Sept. 18. Mr. A. B. Marsden, Manchester, Vt., is secretary and treasurer of the association.

* * *

Cedarmen's Association.—The Northwestern Cedarmen's Association will hold its next annual convention on Jan. 6, 1914. Mr. H. E. Boucher, 743 Lumber Exchange, Minneapolis, Minn., is secretary of the association.

* * *

Empire State Association.—The annual meeting of the Empire State Gas and Electric Association will be held in New York City during the early part of October. Mr. C. H. B. Chapin, 29 West Thirty-ninth Street, New York, is secretary of the organization.

* * *

Convention of the American Water Works Association.—The thirty-fourth annual convention of the American Water Works Association will be held at Philadelphia some time during May, 1914. Mr. J. M. Diven, 47 State Street, Troy, N. Y., is secretary and treasurer of the society.

* * *

Ohio Society of Mechanical, Electrical and Steam Engineers.—The Ohio Society of Mechanical, Electrical and Steam Engineers will hold its annual meeting at Columbus, Ohio, Nov. 20 to 22. Prof. Frank E. Sanborn, Ohio State University, Columbus, Ohio, is secretary and treasurer.

* * *

Annual Meeting of the Railway Telegraph Superintendents.—The annual meeting of the Association of Railway Telegraph Superintendents will be held in New Orleans, La., from May 19 to 22, 1914. Mr. P. W. Drew, 112 West Adams Street, Chicago, is secretary and treasurer of the association.

* * *

Kansas Convention at Hutchinson in October.—The annual convention of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Hutchinson, Kan., Oct. 9 and 10. Succeeding Mr. W. H. Fellows, of Leavenworth, Mr. Ivor Thomas, Wichita, Kan., has been appointed secretary-treasurer.

* * *

Chicago Electrical Credit Association Meeting.—The Electrical Credit Association of Chicago, which is affiliated with the National Electrical Credit Association, will hold its annual convention in Chicago some time in November. Mr. Frederic P. Vose, 1343 Marquette Building, Chicago, is secretary of the Chicago association.

* * *

Chicago Electric Club Picnic.—A real old-fashioned basket picnic has been arranged for Aug. 21 by the Electric Club of Chicago, to be held at Northfield Grove, Ill., about 20 miles northwest of the city. Special cars have been chartered on trains leaving Chicago in the morning and at noon over the Chicago, Milwaukee & St. Paul Railroad, and similar accommodations have been provided for the return trip. Electrical manufacturers, jobbers and dealers have generously furnished prizes for the events, such as vacuum cleaners, percolators, fan motors, toasters, etc. A large attendance is expected, as the president of the club, Mr. George C. Keech, has sent letters to all of the firms whose employees who are members of the Electric Club requesting them to declare a half holiday on that date.

Profitable Station in a Town of 3500 Inhabitants

Rehabilitation of Southern New York Power Company's system at Walton, N. Y.—Methods adopted to increase earnings and improve the efficiency of generation

WHEN, in 1910, the Southern New York Power Company purchased the Walton Electric Light Company and the Walton Public Service Company, both of which were operating in a town which possessed less than 3000 inhabitants, the problem confronting the management was to make a property seventeen years old and giving only night service pay. At that time the yearly gross revenue was less than $3 per capita and the net earnings were not sufficient to meet the interest on nine one-thousand-dollar bonds. The equipment in the generating station was obsolete, consisting of 133-cycle, 1100-volt, single-phase generators and a wooden switchboard. Moreover, owing to a certain weakness in human nature which is very general, the management had during the previous year exchanged the engines and generators for equipment of double the size for no other reason than that the new second-hand equipment could be purchased at a bargain. This resulted in a consumption of 16 lb. of coal per kw-hr. generated, because the units were too large for the work.

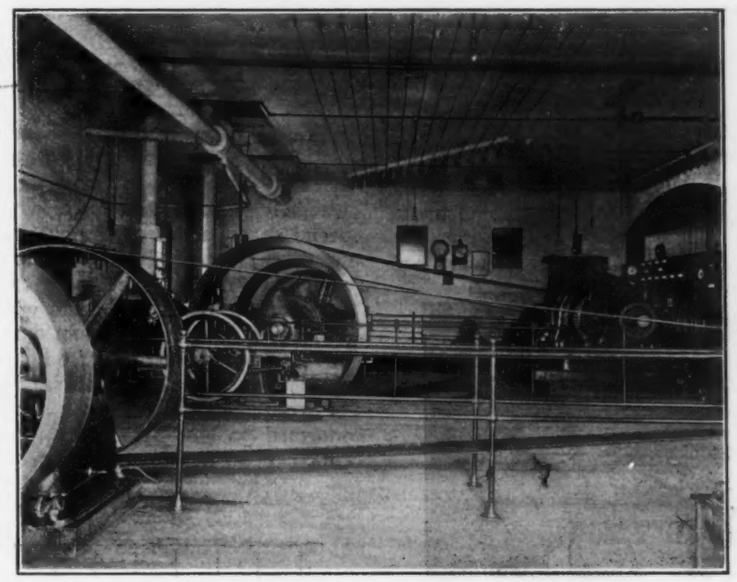


FIG. 1—STATION OF SOUTHERN NEW YORK POWER COMPANY

After a study of the situation, the present management determined to install three-phase, 2400-volt, 60-cycle apparatus and a new switchboard, and to do this it was necessary to build an addition to the power house. In the addition were installed a small engine and generator of such size as to carry the load during the period when the demand was smallest. Moreover it was felt that the quickest way to acquire a day load was to give all-day service rather than to canvass first and then make the change. In the process of rehabilitation all the small transformers were scrapped and all of the Schallenberger meters. A new constant-current transformer, street-lighting system displaced the old shunt-box system and tungsten lamps were installed. The changes were not made simply to modernize the system, but because investigations showed that a sufficient saving in operating expenses warranted such action. From the data and curves published herewith, these facts are brought out more fully. There was no day service given in 1909, and the operating expense per kw-hr. was 6.46 cents, while in 1912, with all-day service, the operating expense was reduced to 3.93 cents. It should not be inferred, however, that the changes were all made at once. Much of the credit for these results is due to the loyalty and enthusiasm of the superintendent and his staff.

In selecting the resident manager, it was decided to take a townsman because the good will of the community was an asset. Of course it would have been an easy matter to select a man with the requisite experience from elsewhere; but he would be a stranger in the community and it would take time for him to establish friendly relations and obtain the confidence of the customers. A resident of the town, even with limited business and engineering experience, would not be thus handicapped; because experience can be acquired by a practical lineman who is not afraid to ask questions. In this connection also it was thought best to pay good wages since an organization employing first-class men is well thought of in a small community, and with sufficient remuneration it is possible to get the best service that a man can give. It is believed that the Southern New York Power Company pays higher salaries than any similar organization in the State, and the employees merit the confidence placed in them. In addition to a stated salary the company gives a bonus of 20 per cent of the increased net revenue.

A change in office management took place with the change in administration. An office having a good show window was opened on the main business street, and a bookkeeper, something which the company had never before possessed, was hired. The bookkeeper is a young woman who also acts as cashier and indoor-appliance saleslady, the latter duty taking up a good part of her time. In handling the accounts of over 500 customers a loose-leaf system of bookkeeping is employed, and in order to expedite the monthly reports an adding machine has been installed. Prior to the installation of the adding machine, it was necessary to employ an assistant to the bookkeeper several days a month, but now the bookkeeper is able to handle all the work unaided.

Before attempting any change in the street-lighting system the village trustees were called together, and the management submitted to them a proposition to increase the number of street lamps by about 40 per cent. Inasmuch as this greater number of lamps could be obtained at an increase of only 15 per cent in cost, the proposition was accepted by the village trustees. To be sure, there was not an enormous profit in the street-lighting contract, but the management believes that municipal street lighting should be taken at a small margin of profit, because it disarms the exponents of municipal ownership of one of their chief arguments and also because it benefits the whole community in that the streets are better lighted. Any general improvement along this line is certain to

work out to the ultimate advantage of the central station.

The amount of industrial business which can be obtained in a small community is limited, so that a small station faces a serious problem whenever more efficient lamps are introduced. It is necessary, therefore, for it to push the sale of electrical appliances such as irons, fans, toasters, etc., in order to keep up the energy consumption per capita, and in the curves reproduced herewith the effect of the tungsten lamp on the maximum demand is apparent. On Jan. 1, 1910, there were 270 customers, and on the same day in 1911, 1912 and 1913 the number of customers was 384, 438 and 502 respectively. The company formerly wired houses at cost and sometimes at less than cost, but this practice has been abandoned without detriment to the business. A first-class electrical contractor has been induced to make his headquarters in the town, and he shares part of the electric company's office and is doing a satisfactory business. In order to curtail the activity of bell-hanger electricians whose work was faulty, the company published in the local papers a year or so ago a statement to the effect that inspection certificates from competent insurance authorities would be required on all new wiring before electric service would be given. This caused a little unpleasantness at the time but resulted in first-class wiring and elimination of many causes for complaint.

DATA ON PLANT EQUIPMENT, ETC.

Item	Jan. 1, 1910	Jan. 1, 1913
Boilers, return tubular	175 hp 125 hp	175 hp 125 hp
Engines, high-speed, simple	250 hp 200 hp	250 hp 200 hp 90 hp
Generators, belted	120 kw 120 kw	175 kw 65 kw 65 kw
Current	Single-phase	Three-phase
Frequency	133 cycles	60 cycles
Voltage	1100 volts	2400 volts
Switchboards	Wooden	Slate
Voltage regulators	None	Two
Street-lighting system	Shunt-box	Constant-current transformer
Street lamps, number	138	178
Street lamps, cp	25	32
Transformers, number	33	48
Transformers, aggregate rating	125 kw	266 kw
Meters, number	220	486
Customers	270	502
Maximum demand, preceding year	98 kw.	145 kw
Kw-hr. generated, preceding year	149,200	289,340
Load-factor, per cent	17	23

FIG. 2—DISTRIBUTION LINES AND STREET LAMPS

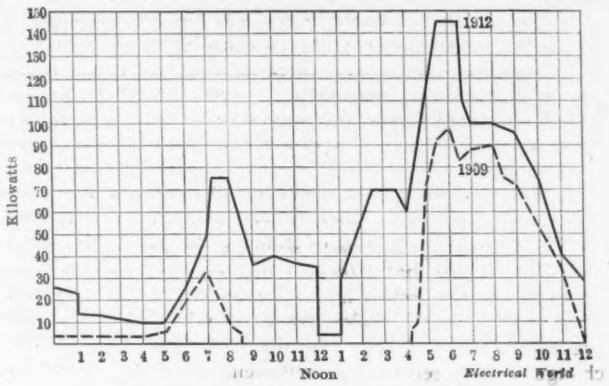


FIG. 3—COMPARISON OF LOAD CURVES

Thus far all of the new business secured has been obtained without employing a salesman inasmuch as every employee is a booster for the company. All of the business in sight, however, has not been secured, and it is proposed to engage an experienced salesman for a short time to make a complete canvass of the village and accelerate the demand. Although the company has over 500 customers, it has not a single written contract or a single special contract, all of the customers being billed according to the rates which were inherited when the plants were taken over. The rates for lighting service are 12 cents per kw-hr. and 10 cents where the business exceeds $5 a month, with a maximum monthly charge of 50 cents. There are also a few flat-rate lighting customers connected to the circuits on the basis of 2 cents per watt per month. For motor service there is a charge of $1 per month per connected hp, and in addition an energy charge of 5 cents per kw-hr. for the first 200 kw-hr. per month, 4 cents per kw-hr. for the next 300 kw-hr., and 3 cents per kw-hr. for any excess. The average revenue from motor service is 5.75 cents per kw-hr. Of the total revenue of the company 10 per cent is obtained from street lighting, 2.5 per cent from flat-rate lighting, 65 per cent from metered lighting service, 20 per cent from motor service, and 2.5 per cent from merchandise and jobbing work.

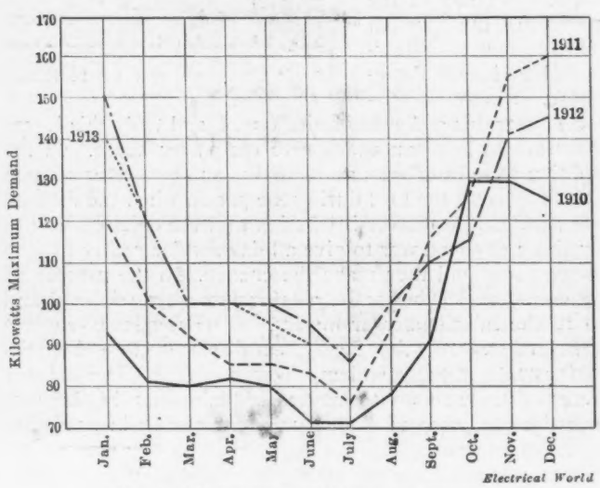


FIG. 4—MAXIMUM DEMAND AT STATION

For a time some little difficulty was experienced in getting customers to pay bills promptly and it was proposed to

offer discounts for prompt payment or else to employ a collector. After mature consideration it was felt that the giving of discounts would not interest the class of people who were backward in meeting their obligations, so in place of the boy who was employed three or four days a month to read meters, and also in place of a lineman's helper, a first-class all-round man was engaged to perform the duties of these two and also act as collector. In this way the personal friendship excuses for not paying bills which the superintendent had to consider were eliminated. The company now employs three men for the power house, a combination lineman, meter reader, meter tester and collector, a bookkeeper and superintendent. An additional man is hired to act as a groundman on line work when necessary.

To what extent it is possible to effect economies in the operation of a small station is well illustrated in the table which is given on this page showing the generating costs. It will be noted that although in 1909 there was no daylight service the cost of labor, fuel, water and supplies was greater than in the following years when all-day service prevailed. A saving in this direction was effected by a change in the generating equipment, as noted in the beginning of this article, and also by the better load-factor. However, expert supervision also played an important part in the result, and to this may be traced the items on repairs to boilers, engines and generators, which, while not large in the aggregate, have a marked bearing on the amount of coal and water consumed per unit generated. Fortunately, the engineer in charge of the Walton plant is also the best mechanic in the village and his time is not so taken up that he cannot look after the repairs around the station while on duty. For that purpose a small machine shop has been fitted up for his benefit, where most of the machine work required for the station is done.

In Fig. 5 is given a view of the rear of the switchboard, which replaced one of wood. The instruments and apparatus on this board were of course purchased, but all of the other work on the board was done by the company itself at a great saving. The usual array of instruments is provided in addition to a frequency indicator. The latter is not always included in the switchboard equipment of a small station, but has proved its worth many times. An important use is made of it to detect when the spring of the engine governor becomes weak. At such times the speed of the engine decreases, and of course the frequency drops and the motors on the line do not run up to speed. In a manufacturing plant slow speed means decreased output and dissatisfaction with electric service, and a refinement such as a frequency indicator at small expense was deemed worth while in Walton for the reason stated.

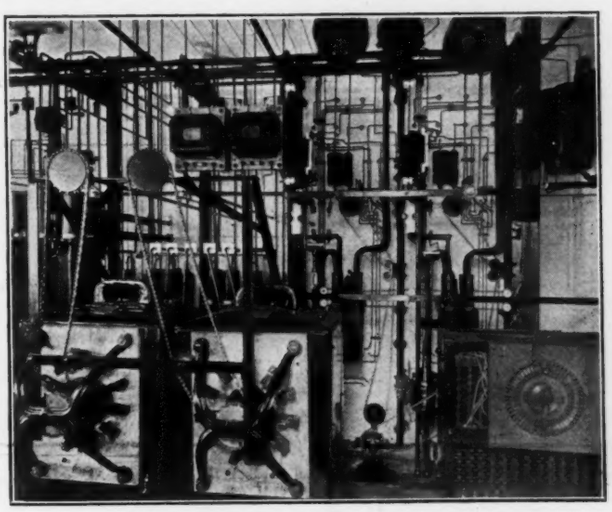


FIG. 5—REAR VIEW OF SWITCHBOARD

The company gives twenty-three and one-quarter hours' service daily except on Sundays. On that day unless it is cloudy or raining the plant is shut down during the day to allow repairs in the power house and changes on the line to be made. In addition, the station is shut down during the noon hour daily, during which time minor repairs can be made and new customers cut in on the circuits. Should any of the mills require service during the noon hour, however, a telephonic request to the superintendent is all that is required to keep the station in operation during that period. By operating the units in the station to advantage according to the load and by weighing the coal and improving the piping layout in the station, the company has doubled its gross earnings and is now getting over $6 per capita per year with a profit of several thousand dollars, whereas previously there was no profit at all, but a loss. Fig. 6 shows the relation existing between the coal consumption per kilowatt-hour with increased load-factor and supervision. The curve is made up from monthly reports of kilowatt-hours generated and coal consumption with reference to the maximum demand of the year and shows that as the load-factor increases the coal consumption decreases. The officers of the company are as follows: President, Mr. C. A. Graves; treasurer, Mr. R. C. McGargel, and manager, Mr. F. Haverly.

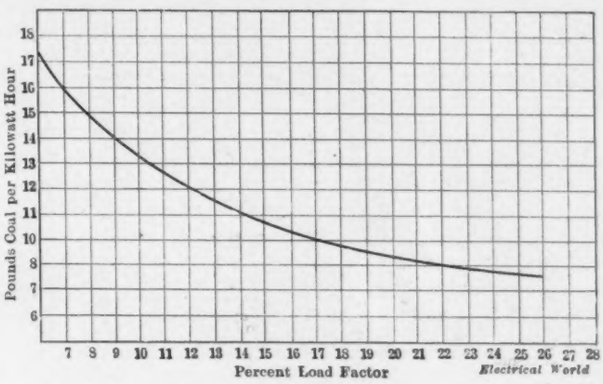


FIG. 6—RELATION OF COAL CONSUMPTION AND LOAD-FACTOR

COST IN CENTS PER KW-HR. GENERATED

	1909	1910	1911	1912
Station labor	0.87	0.88	0.80	0.73
Fuel	2.16	1.78	1.43	1.23
Water	0.05	0.05	0.03	0.02
Supplies	0.19	0.17	0.15	0.15
Repairs, building	0.01	0.02	....	0.03
Repairs, boilers	....	0.09	0.11	0.05
Repairs, engines	0.15	0.06	0.05	0.0
Repairs, generators	....	0.05	0.01	....
Repairs, accessories	....	....	....	....
Repairs, miscellaneous	....	....	....	....
Total production	3.43	3.10	2.58	2.24
Distribution superintendence	0.24	0.20	0.26	0.25
Moving meters and transformers	....	....	0.01	....
Repairs, distribution mains	....	0.06	0.14	0.09
Repairs, services	....	....	0.00	0.01
Repairs, transformers	0.09	....	0.01	....
Repairs and operation of meters	....	0.34	0.01	0.04
Total distribution	0.33	0.60	0.43	0.39
Commercial incandescent operation	0.23	0.19	0.21	0.14
Street-lighting operation	0.09	0.15	0.02	....
Street-lighting, repair	....	0.03	....	....
Total utilization	0.32	0.37	0.23	0.14
Total commercial	....	....	0.05	0.03
Total general	2.38	1.38	1.18	1.00
Total operating	6.46	5.45	4.47	3.93
Kw-hr. generated	149,200	163,000	250,427	289,340

Present Status of the Locomobile

By Warren H. Miller

More than two years have elapsed since the writer reported in the *Electrical World* his observations of the so-called locomobile then in use in Germany but unknown here. This type of machine is now being built in America

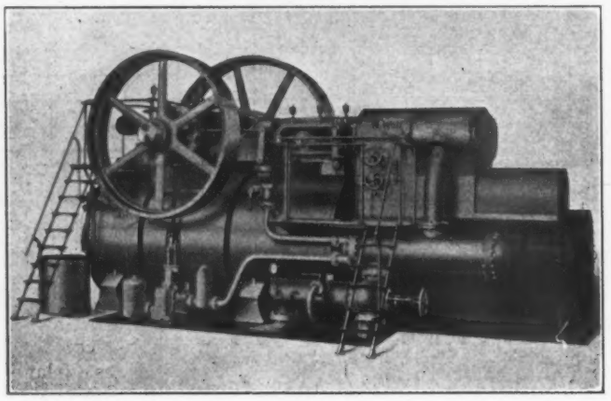


FIG. 1—WOLF 130-HP TANDEM-COMPOUND LOCOMOBILE WITH SINGLE SUPERHEATER

and the subject therefore becomes of increasing interest to *Electrical World* readers. In view of this interest it seems well to give a brief outline of the machine, even the name of which is somewhat confusing by reason of its use in connection with a well-known automobile.

The name "Lokomobile" was given by the Germans to a combination of boiler, engine and superheater, compactly assembled for the purpose of eliminating radiation and piping losses. Cylinder condensation has been to a large extent done away with by carrying the superheating up to nearly 600 deg. The engine is mounted on top of the boiler, even in units as large as 1000 hp, and with it is mounted the generator if the installation is designed for producing electrical energy. The saving in floor area is remarkable, the 1000-hp Lanz unit, which supplied nearly all the electric lighting and motor service for the Brussels Exposition in 1910, taking only 24 ft. by 32 ft. of floor area.

Loss of heat is minimized by jacketing the high-pressure

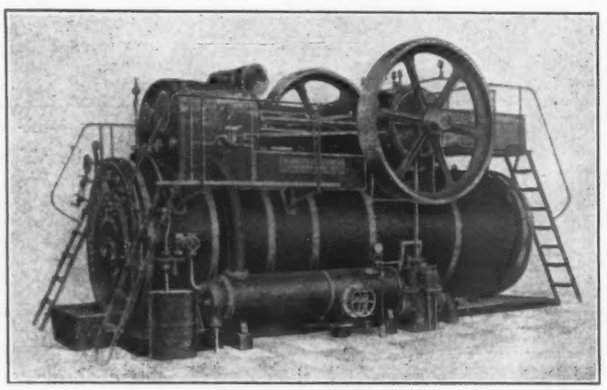


FIG. 2—LANZ 210-HP CROSS-COMPOUND, SINGLE-SUPERHEAT LOCOMOBILE

and low-pressure cylinders, either by mounting them in the steam dome of the boiler or by putting them in the chimney uptake, where the waste heat gases serve not only to prevent radiation losses but even, in the case of the low-pressure cylinder, to return a certain amount of heat through the cylinder walls. To insure that the economy will not fall off through boiler scale and superheater soot-

ing, the furnace and tubes are removable. The boiler is fired internally, being provided with a corrugated furnace, and the front and rear plates are bolted to the flange of the boiler shell and made tight with a special packing. The entire equipment is very handsomely got up, and, as the engine and the boiler are in one unit, both must be kept clean. The fuel consumption being very low, one man usually runs both the engine and the boiler, in all sizes up to about 250 hp. Automatic stokers and low heat-value fuels are much in favor for use with the locomobile for the same reason.

The rate of introduction of these machines in Europe and all her trade dependencies during the last twelve years has been phenomenal. In Germany, France, Russia, Italy, Holland and Belgium there are over 50,000 installations at present, ranging in size from 40 hp up to 1000 hp. They are used for every conceivable service such as with mill shafting, pottery machinery, mine crushers, woodworking shops, machine and tool works, electric generation and industrial plants where use is made of three-phase induction motors.

The every-day working fuel consumption of these plants averages from 1.1 lb. to 1.4 lb. (of 13,000 b.t.u.) coal per brake hp-hr. and the specific consumption does not vary either with the size of the plant or the load. It does not rise appreciably at three-quarters and one and one-quarter load, and at half-load is about 0.2 lb. of coal more. The

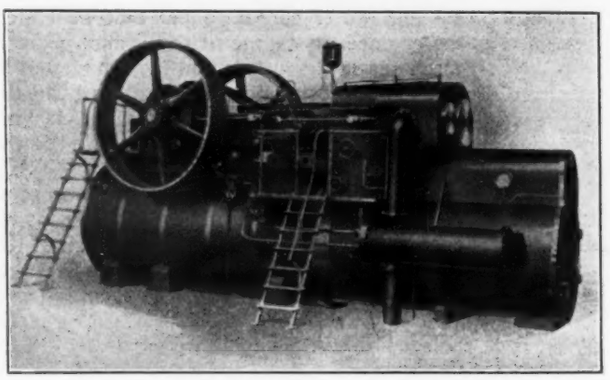


FIG. 3—150-HP DOUBLE-SUPERHEAT AMERICAN LOCOMOBILE

world's record for economy is held by a 130-hp Wolf locomobile, one of which supplies the electric lighting for the Czar's palace at Peterhof, where the steam consumption is 7.06 lb. and the coal 0.74 lb. per brake hp-hr. The 1000-hp Lanz locomobile at the Brussels Exposition consumed 9.2 lb. steam and 1.1 lb. coal per hp-hr. in the day's run tests, the difference between it and the Wolf engine undoubtedly being due to double superheat of the latter and the jacketing of the cylinders with the chimney gases instead of with the boiler saturated steam, as is the case with all the Lanz engines.

In an article in the *Electrical World* on April 6, 1911, the writer reported the results of some personal investigations of the every-day efficiency of the locomobile throughout Germany, in which the fuel consumption was found to average about 1.3 lb. for good soft coal and 2.4 lb. per hp-hr. for the brown coal (of about 7000 b.t.u. per lb.) which is extensively used there in factory service. The Lanz and Wolf locomobiles at Brussels in 1910 were found to run very smoothly, and tachometer measurements showed them amply able to drive alternating-current generators in parallel, as indeed has been done in dozens of installations since that date, notably in South America, where advanced engineering practice by young German and French engineers is the rule rather than the exception.

Herewith are illustrated two standard types of German locomobiles, Fig. 1 showing a 200-hp Lanz unit, single superheater, with cylinders jacketed in the steam dome, and

Fig. 2 a Wolf unit with double superheater and cylinders jacketed in the chimney uptake. Each of these 130-hp units possesses the feature of removable corrugated furnace and tubes, the engine and boiler being arranged as one unit, the principal difference being in the form of the superheater and the type of valve gear employed. As will be noted with the Lanz machine, the cylinders are jacketed by casting them and the dome in one piece of tough gray iron, with space for the circulation of the saturated boiler steam. The Wolf company makes a large number of machines of this type, ranging from 250 to 1200 hp, but of late has been concentrating more upon the double superheater type shown in Fig. 2. The latter is made in ratings from 80 hp up to 400 hp and has a number of notable features. After passing over the usual coil superheater the chimney gases enter a second superheater of the multiple type, inside of which is exhausted the steam from the high-pressure cylinder. The temperature of the exhaust is about 260 deg. Fahr.; the chimney gases raise the temperature to about 370 Fahr. before the steam enters the low-pressure cylinder. In this way the steam is superheated in each cylinder sufficiently to eliminate cylinder condensation loss without imposing an excessively high initial temperature.

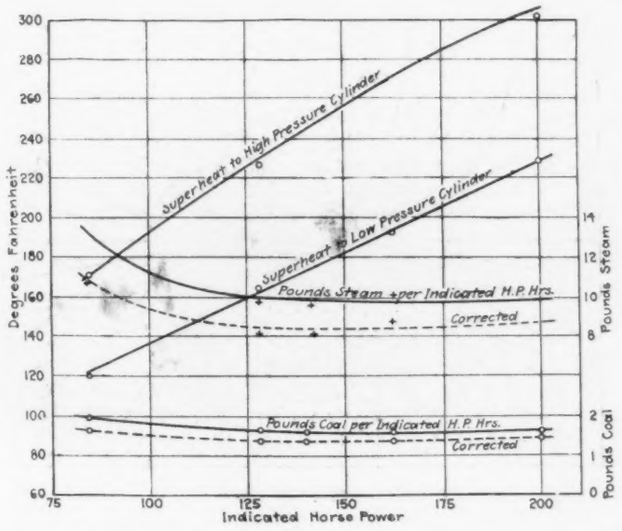


FIG. 4—RESULTS OF TESTS ON 150-HP BUCKEYE-MOBILE SHOWN GRAPHICALLY

In the Lanz type of machine use is made of a single trombone superheater, and the initial temperature is carried up to 610 deg. Fahr. as compared with 570 deg. for the Wolf unit. Whether the greater simplicity of the Lanz type does not more than repay for the more or less chimerical disadvantage of a high initial super-temperature is a subject under dispute in German technical circles.

The Lanz valve gear is of the pop-valve type, while that of the Wolf is of the well-known piston type. The former undoubtedly gives better steam distribution and has no frictional troubles, but the highly superheated steam surrounds the pop-valve stem so that a labyrinthine packing and ground metal bushing must be used, whereas with the Wolf unit the stem of the valve is on the exhaust steam side so that ordinary packing can be used. There are at least four other companies in Germany manufacturing the locomobile, and many of its features are common property.

In this country the Buckeye Engine Company of Salem, Ohio, has placed on the market its own line of locomobiles, having secured certain indispensable patent rights. In the American locomobile use is made of the double superheat and smoke gas cylinder-jacket principle. An illustration of the first American-built locomobile is shown in Fig. 3. It is of 150 hp normal rating. The author ran three tests with it on three-quarters load, one and one-quarter load and with full load, of from three to eight hours' duration, and got a consumption of 11.2 lb. of steam and 1.6 lb. of coal per hp-hr.—a good result for a first design. The principal measurements made during the test are indicated in Fig. 4. Tests were conducted in accordance with standard A. S. M. E. regulations; coal and water were weighed as fed and readings were taken every fifteen minutes. The American built locomobile is much like the Wolf type of unit with double superheat and smokestack cylinder jacketing, but it contains a number of notable mechanical improvements.

In operation the American machine falls short of the performances of the Lanz and Wolf machines in Germany even on the indicated-horse-power basis, whereas all the foreign figures mentioned relate to the brake-horse-power. However, this is a first machine, and, at that, its performance is nothing to be ashamed of. How many saturated-steam engines of 150 hp in this country can touch or even approximate 1.6 lb. of coal per indicated-horse-power-hour?

As might be expected, the Germans have not been asleep during the two years that we have been developing the American locomobile. Their latest contribution comes in the shape of a uniflow cylinder applied to a series of large locomobiles made by the Wolf company. These units range from 300 hp to 800 hp and are of the cross-compound type, with uniflow cylinders for both high and low pressure. Single superheat only is used in this type and the results so far obtained show 8.05 lb. of steam per indicated-horse-power-hour, as tested at the University of Prague. While the application of the uniflow-cylinder principle to a machine already eliminating cylinder condensation by high superheat may seem to be wasted pains, the logic back of this new unit is very simple.

Formulas for Capacity of Single-Phase Transmission Lines and Cables

By C. A. Pierce and F. J. Adams

Practically all formulas for computing the capacity of transmission lines or cables are based on the assumption that the surfaces of the conducting wires, and the inside surface of the armor sheath in the case of cables, are equipotential surfaces and that the charges are distributed uniformly over the surfaces of the conductors. This assumption has sometimes been plainly stated, though in most cases it is not mentioned, and one finds it to be implicitly included in the hypothesis only when one analyzes the formulas, giving especial attention to the assumptions and approximations involved. The following article will include the deduction of some formulas for computing the capacities of single-phase transmission lines and cables, and particular attention will be given to the assumptions underlying the formulas and to the accuracy which may be expected when they are used.

The Potential of a Long, Straight Cylindrical Conductor

The potential of a long, straight cylindrical conductor, when charged with a quantity of electricity and supposed to occupy the whole field of force alone, is defined as the work done upon a unit positive electric charge when this unit charge is carried from the wire to a region where the field of force is zero. Since the potential is independent of the path along which the unit charge is carried, it is usual to suppose that the charge is carried along a path described by a radius of the conductor extended to the limit of the field. The work is then equal to

$$W = \int F\, dr$$

where F is the force exerted upon the unit charge at any point in the path and dr is an infinitesimal length of the path. The force F is equal to the number of lines of elec-

trostatic force crossing unit area normal to r at the point where F is considered. Since $\frac{4\pi}{k}$ lines of force originate upon unit charge, where k is the specific capacity of the dielectric surrounding the charge, $\frac{4\pi Q}{k}$ lines of force will originate upon unit length of the conductor, if Q is the charge upon unit length thereof. Owing to symmetry, these lines will radiate as equally spaced straight lines from the surface of the conductor, except near the ends. Hence the density of lines at any point, P, outside of the conductor and not near the ends, is equal to

$$F = \frac{4\pi Q}{2\pi r \times 1 \times k} = \frac{2Q}{kr}.$$

The expression for the work now becomes

$$W = \int \frac{2Q}{kr}\, dr.$$

Exactly this same expression will be obtained if one considers the charge Q to be concentrated along unit length of the axis of the conductor. It will be noticed that the assumption of equally spaced lines radiating from the surface of the conductor tacitly assumes that the surface of the conductor is an equipotential surface and that the charge is uniformly distributed over its surface.

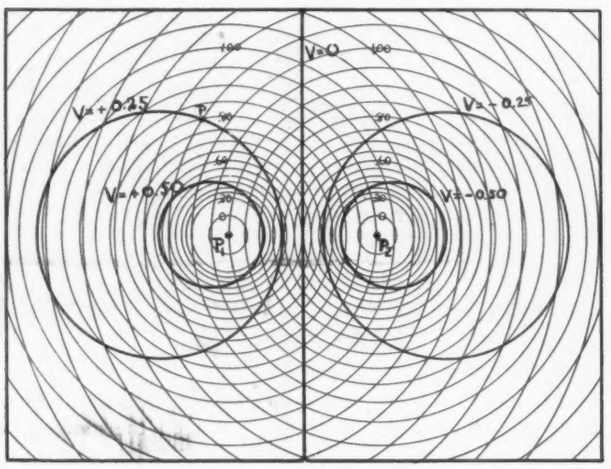


FIG. 1—EQUIPOTENTIAL SURFACES CAUSED BY TWO EQUAL BUT OPPOSITE PARALLEL LINEAR CHARGES

The absolute value of the potential of the charged conductor is equal to

$$V = W = \int_{r_1}^{r} \frac{2Q}{kr}\, dr = \frac{2Q}{k}\left[\log r\right]_{r_1}^{r}$$

The upper limit is at an infinite distance from the conductor and the expression for V is of no value in this problem. In the following work the absolute value of the potential of the conductor is not required; rather, it is the potential difference of two points in space due to the charged conductor which is useful. The potential difference of any two points, P_2 and P_3, situated distances r_2 and r_3 normally from the axis of the conductor is equal to the work done upon a unit positive charge when it is carried from one point to the other, and is

$$V = V_2 - V_3 = \int_{r_2}^{r_3} \frac{2Q}{kr}\, dr = \frac{2Q}{k} \log \frac{r_3}{r_2} \qquad (1)$$

It is to be noted that this expression holds whether the charge Q is distributed uniformly upon the surface of any cylindrical conductor or is concentrated at the axis of the conductor. The only limitation is that the radius of the conductor must be less than either r_2 or r_3.

The Potential Difference of Two Long, Straight Parallel Cylindrical Conductors Equally but Oppositely Charged

If the surfaces of two straight, parallel cylindrical conductors are assumed to be equipotential surfaces when one is charged with $+Q_1$ units of electricity per unit length and the other with $-Q_2$ units ($Q_1 = Q_2$ numerically), the potential difference between them, assuming that they alone occupy the field of force, will be equal to

$$V = W = \int_{r_1}^{D-r_1} \left(\frac{2Q_1}{kr} - \frac{2Q_2}{k(D-r)}\right) dr,$$

provided that it is assumed that the charges are evenly distributed over the surfaces of the conductors.

As will be seen in Fig. 1, the potential changes sign at the neutral midway between the conductors, consequently the equation above can be handled more easily if we write

$$V = W = 2\int_{r_1}^{D/2} \left(\frac{2Q_1}{kr} - \frac{2Q_2}{k(D-r)}\right) dr$$

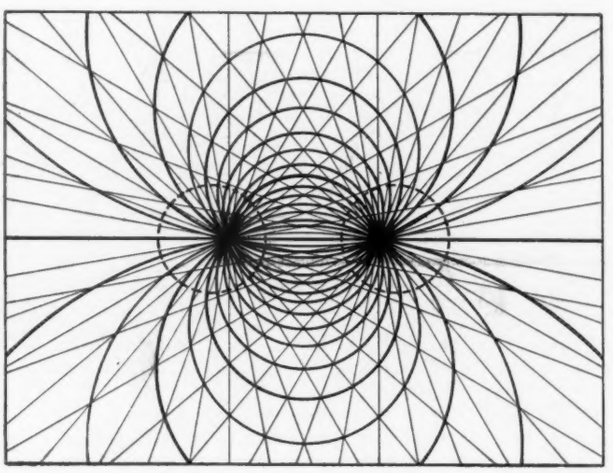


FIG. 2—LINES OF FORCE BETWEEN TWO EQUAL AND OPPOSITE PARALLEL LINEAR CHARGES

$$= \frac{4Q_1}{k} \log \frac{D-r_1}{r_1} \text{ electrostatic units} \qquad (2)$$

where D is the distance between the axes of the conductors and r_1 is equal to the radius of either conductor. But the two charged conductors do not give rise to equipotential surfaces which coincide with the surfaces of the conductors except when the charges are not uniformly distributed over the surfaces of the conductors, as will be shown later. Hence equation (2) can be only approximately true and it becomes of interest to ascertain the degree of approximation and, if possible, to deduce an equation which is exactly correct.

In order to solve this problem, it is convenient to find the equipotential surfaces for the two charges when they are concentrated along the axes of the two parallel conductors. This can be done in a manner similar to that already developed by Clerk Maxwell for the case of two point charges.* Fig. 1 represents a cross-section normal to the two axes, P_1 and P_2, along which the charges, $+Q_1$ and $-Q_2$ ($Q_1 = Q_2$ numerically) per unit length, are concentrated. The equipotential surfaces for P_1 alone are represented by the circles concentric with P_1. As it is not convenient to use absolute potentials, the circles are drawn to represent potential differences. That is, the potential dif-

*See Chapter VII, Vol. I, "Electricity and Magnetism," by Clerk Maxwell.

ference of circles marked 0.80 and 0 is, by equation (1), equal to

$$V = \frac{2Q_1}{k}\int \frac{dr}{r} = 4.6\,\frac{Q_1}{k}\log_{10}\frac{r_\infty}{r_0}.$$

As the figure is drawn for the case where air is the dielectric, k is equal to unity. For convenience in drawing the figure, $4.6\,Q_1$ was taken equal to unity, making $Q_1 = 0.217$. In a similar manner the equipotential surfaces for P_2 are drawn. Now, consider some point, as P, in the field. The potential at P is equal to the algebraic sum of the two potentials at P due to the two charges Q_1 and Q_2 separately.

As the absolute values of the potentials are not known, some means must be found for using the differences of potential which are available in the figure. Assume that the equipotential circle drawn around P_1 and marked zero is at some absolute potential, which we may call V. Then by construction the potential at P due to the charge at P_1 is equal to $V - 0.80$ unit. Likewise the potential at P due to the charge at P_2 is equal to $-(V - 1.05)$ units. Hence the potential at P due to both charges is equal to

$$V - 0.80 - (V - 1.05) = +0.25 \text{ electrostatic unit.}$$

In a similar manner, the potential at any point in the field can be found, and, furthermore, by connecting all points of the same potential, an equipotential surface can be lo-

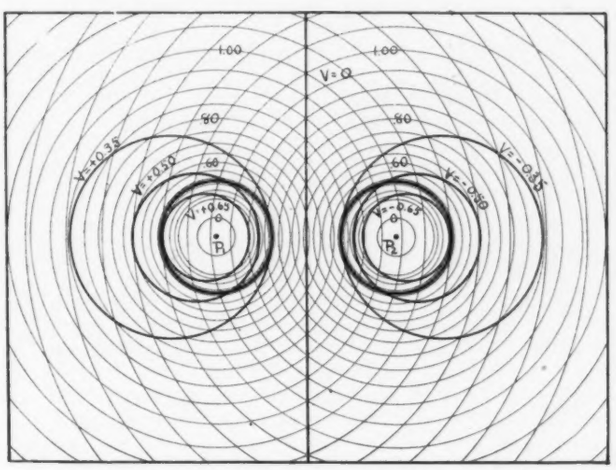


FIG. 3—ANOMALOUS POTENTIAL DISTRIBUTION WHEN CHARGE ON EACH CONDUCTOR IS ASSUMED TO BE UNIFORMLY DISTRIBUTED ABOUT PERIPHERY

cated. Several equipotential surfaces are indicated in the figure by the heavy lines. They are seen to be of circular cross-section, but are not concentric about P_1 and P_2. Now, if we suppose that any two equipotential surfaces, such as $V = +0.50$ and $V = -0.50$ in Fig. 1, are replaced by conductors, and if we suppose that these conductors are charged with $+Q_1$ and $-Q_2$ units of electricity per unit length (in other words, with the same charges that P_1 and P_2 had), the equipotential surfaces outside the conductors will remain the same as they were for the concentrated charges at P_1 and P_2 (see previous reference). The potential difference between these new conductors is then equal to

$$+0.50 - (-0.50) = 1.00 \text{ electrostatic unit.}$$

It must be kept in mind that this is the true potential difference between the two conductors which replace the equipotential surfaces $V = +0.50$ and $V = -0.50$ in Fig. 1, and takes account of the fact that the charges are not uniformly distributed over the conductors.

The distribution of electricity over two conductors which coincide with any two equipotential surfaces, such as $V = +0.50$ and $V = -0.50$ in Fig. 1, will not be uniform and can be found by drawing the lines of force in a manner similar to that used by Clerk Maxwell in the case of charged spheres (see reference above). Fig. 2 shows the lines of force corresponding to the two concentrated linear charges shown in Fig. 1. The lighter continuous lines in Fig. 2 are the construction lines for the lines of force which are shown by heavy continuous lines. Two equipotential surfaces, $V = +0.50$ and $V = -0.50$, are shown in Fig. 2 by the dotted circles. The lines of force

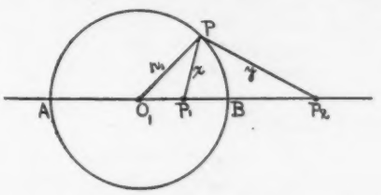


FIG. 4—METHOD OF CONSTRUCTING EQUIPOTENTIAL SURFACES FOR TWO PARALLEL CONDUCTORS EQUALLY BUT OPPOSITELY CHARGED

between two conductors which coincide with any two equipotential surfaces and are charged with $+Q_1$ and $-Q_2$ units of electricity respectively are coincident with those portions of the lines of force for the concentrated charges which lie between the two conductors. The density of the charge over the surfaces of the conductors is shown by the density of the lines of force over the surfaces of the conductors. As can be seen in Fig. 2, the charges are drawn toward the adjacent sides of the conductors represented by the dotted lines, which is the result one would expect on account of the mutual attractions of the charges.

By a proper choice of constants the number of lines of force in Fig. 2 could have been made equal to $4\pi Q_1$, but this did not seem worth while, so the lines of force are drawn proportional to $4\pi Q_1$.

By referring to Fig. 1, it will be seen that if one considers two conductors having radii equal to the radii of two equipotential surfaces $V = +0.50$ and $V = -0.50$, and coincident in space with these two surfaces, the potential difference between them will be 1 electrostatic unit if one conductor is charged with $+Q_1 = +0.217$ units of electricity and the other with $-Q_2 = -0.217$ units. The error made by applying formula (1) is found by substituting the geometric constants of Fig. 1. As originally drawn to scale, the distance between the centers of the two conductors was scaled off as 8 units. The radii of the two conductors were scaled off as 2.87 units. Hence the difference of potential between them according to formula (1) is

$$V = 4\,Q \log\frac{5.13}{2.87} = 9.2 \times 0.217 \log_{10}\frac{5.13}{2.87}$$

$$= 0.506 \text{ electrostatic unit.}$$

The difference between the true value 1 and the value 0.506 is accounted for by the fact that the electric centers and the geometric centers of the conductors do not coincide, on account of the non-uniform distribution of the charges over the surfaces of the conductors.

FIG. 5—METHOD OF CONSTRUCTING EQUIPOTENTIAL SURFACES FOR TWO PARALLEL CONDUCTORS INCLOSED BY A CYLINDRICAL METALLIC ENVELOPE AND SCREEN

The error made by considering the electric centers of the conductors to be coincident with the geometric centers is further brought out in Fig. 3. The two heavy circles concentric with P_1 and P_2 represent the conductors discussed above. The electric centers are supposed to be at P_1 and P_2. The equipotential surfaces are constructed as in Fig.

1. As will be seen in the figure, the surfaces of the conductors will not be equipotential surfaces if the electric centers are supposed to coincide with the geometric centers. In fact, the potential difference of the adjacent surfaces of the conductors is seen to be about 0.70 unit, while that of the further surfaces is seen to be about 1.30 units. This figure therefore shows that the supposition of uniform distribution over the surfaces of the conductors does not lead to a conclusion that the surfaces of the conductors are equipotential surfaces.

Capacity per Unit Length of Two Straight Parallel Cylindrical Conductors

The two conductors may be considered to form a condenser. The capacity per unit length of conductor is, then, equal to

$$C = \frac{Q}{V}$$

where Q is the charge per unit length of one conductor and V is the potential difference of the two conductors. This expression is usually considered to hold only when the charge is uniformly distributed over the surface of the conductor and the surface of each conductor is an equipotential surface. The expression is true, however, if only the second condition is fulfilled. Consider the surfaces of the conductors to be made up of infinitesimal sections. Then

$$C = \int dC = \int \frac{dQ}{V} = \frac{Q}{V}.$$

Since formula (2) has been found not to give exactly the true potential difference of the two conductors, it cannot be used to derive the true formula for capacity, which is ordinarily given as

$$C = \frac{Q}{V} = \frac{Qk}{4\,Q \log \frac{D-r}{r}} = \frac{k}{4 \log \frac{D-r}{r}}$$

$$= \frac{k}{9.2 \log_{10} \frac{D-r}{r}} \text{ electrostatic units.}$$

Construction of the Equipotential Surfaces for Two Straight Parallel Cylindrical Conductors

The equipotential surfaces found in Fig. 1 may be drawn much more readily than by the method used to construct Fig. 1. In Fig. 4 let P_1 and P_2 be the electric centers with concentrated charges $+Q_1$ and $-Q_2$ ($Q_1 = Q_2 = Q$ numerically) per unit length. The potential at any point, P, in the field is the algebraic sum of the separate potentials due to each charge alone. It is expressed by

$$V = V_0 - 2\,Q \log \frac{x}{r} - \left(V_0 - 2\,Q \log \frac{y}{r}\right)$$

$$= -2\,Q \log \frac{x}{y},$$

where r is the radius and $2V_0$ is the potential difference of a pair of equipotential reference surfaces around P_1 and P_2. The locus of all points for which V equals a given constant represents a desired equipotential surface through P. If we suppose the potential at P to be found, then the equation of the equipotential surface through P is

$$\frac{x}{y} = \log^{-1} \frac{V}{2\,Q} = \text{a constant.}$$

This condition is satisfied when P_1 and P_2 are two inverse points of the circle which represents the equipotential surface.† And, conversely, the locus of $x \div y =$ a constant is a circle of inversion for the inverse points P_1 and P_2. Reference to Fig. 1 will recall the fact that the equipotential surfaces have already been shown by construction to be circular in cross-section. The circles for the different surfaces may now be drawn according to the relations derived from the theory of inverse points, but it seems easier to get at the positions of the centers of the circles together with their corresponding radii in the following manner:

Let A and B, Fig. 4, be the points where the equipotential surface through P cuts the line through P_1P_2. Let the distance $P_1P_2 = C$, $BP_1 = z_1$ and $AP_1 = z_2$. The potential at B is equal to

$$V_1 = -2\,Q_2 \log \frac{C - z_1}{r} + 2\,Q_1 \log \frac{z_1}{r},$$

while that at A is equal to

$$V_2 = -2\,Q_2 \log \frac{C + z_2}{r} + 2\,Q_1 \log \frac{z_2}{r}.$$

But B and A lie on the same equipotential surface. Therefore

$$\log \frac{C - z_1}{r} - \log \frac{z_1}{r} = \log \frac{C + z_2}{r} - \log \frac{z_2}{r}$$

$$\log \frac{C - z_1}{z_1} = \log \frac{C + z_2}{z_2}$$

$$\frac{C - z_1}{C + z_2} \times \frac{z_2}{z_1} = 1$$

$$\therefore \quad z_1 = \frac{C z_2}{C + 2\,z_2}. \tag{3}$$

z_1 is determined by equation (3) if z_2 is known. But z_2 can be determined from the relation

$$V = V_1 \text{ or } V_2 = -2\,Q \log \frac{C + z_2}{r} + 2\,Q \log \frac{z_2}{r}$$

$$= -2\,Q \log \frac{C + z_2}{z_2} \tag{4}$$

$$z_2 = \frac{C}{1 - \log^{-1} \frac{V}{2\,Q}} = \frac{C}{1 - 2.3 \log_{10} \frac{V}{2\,Q}}. \tag{5}$$

If V is given various values, z_2 and z_1 can be determined. Now, the radius of an equipotential surface is equal to $\frac{1}{2}(z_1 + z_2)$ and the distance O_1P_1 in Fig. 4 is equal to $\frac{1}{2}(z_2 - z_1)$. Hence the positions of the centers, as well as the radii, of the equipotential surfaces are determined.

While formulas (3) and (4) are adapted to the drawing of equipotential surfaces for two concentrated charges, P_1 and P_2 (Fig. 4), they are not in a convenient form for the determination of the potential difference between two straight parallel cylindrical conductors. Suppose that one desires to determine the potential difference of two conductors which coincide with the equipotential surfaces, $V = +0.25$ and $V = -0.25$ (Fig. 1). Let D equal the distance apart of the axes of the conductors and r_1 equal the common length of their radii. Turning to Fig. 4, let the equipotential surface PAB represent one of the conductors; a similar circle (not drawn) around P_2 will represent the other conductor. Since the surfaces of the conductors are equipotential surfaces, the points P_1 and P_2 (position of both as yet undetermined) are inverse points with the cross-section of either conductor corresponding to a circle of inversion. Hence

$$P_1O_1 \times P_2O_1 = (O_1P)^2 = r_1^2,$$

but

$$P_2O_1 = D - P_1O_1,$$

hence

$$P_1O_1\,(D - P_1O_1) = r_1^2,$$

and

$$P_1O_1 = \frac{D}{2} \pm \sqrt{\frac{D^2}{4} - r_1^2};$$

but

$$z_2 = r_1 + P_1O_1,$$

also

$$C = D - 2\,P_1O_1,$$

†See Chapter XI, Vol. I, "Electricity and Magnetism," by Clerk Maxwell.

hence, by substitution in equation (4),

$$V = -2Q\log\frac{r_1+\frac{D}{2}\mp\sqrt{\frac{D^2}{4}-r_1^2}}{r_1+\frac{D}{2}\pm\sqrt{\frac{D^2}{4}-r_1^2}},$$

or the potential difference of the two wires is equal to

$$2V = -4Q\log\frac{r_1+\frac{D}{2}\mp\sqrt{\frac{D^2}{4}-r_1^2}}{r_1+\frac{D}{2}\pm\sqrt{\frac{D^2}{4}-r_1^2}}. \qquad (6)$$

The minus sign for the potential occurs because equation (4) is based on an equation which contains both $+Q_1$ and $-Q_2$ and proper care was not observed in the use of these signs. The matter is unimportant because if one wire is at a higher potential than the other, the difference of potential is positive or negative according to the point of view.

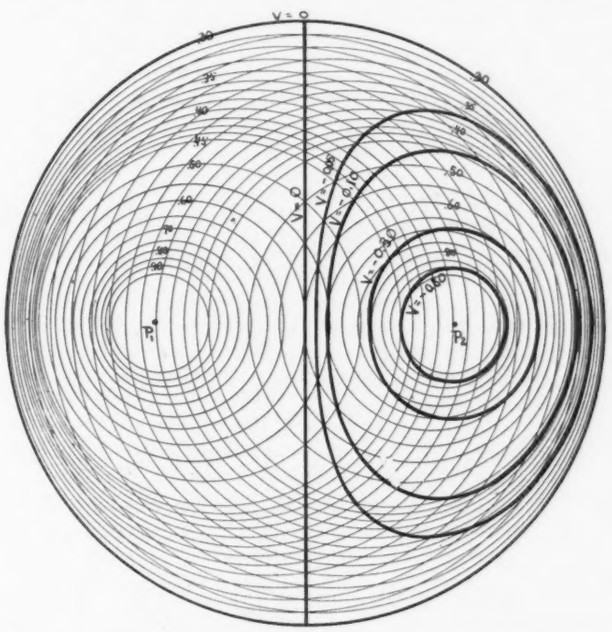


FIG. 6—EQUIPOTENTIAL SURFACES WITHIN A CABLE SHEATH SET UP BY PARALLEL LINEAR CHARGES OF EQUAL MAGNITUDE BUT OPPOSITE SIGN

Formula (6) may be checked by Fig. 1. The constants for the equipotential surfaces, $V = +0.50$ and $V = -0.50$, as originally drawn to scale, are $D = 2.46$, $r_1 = 0.70$ and $Q = 0.217$, so that

$$2 \times 0.217 \times 2.3 = 1.00$$

By formula (6), using the lower sign of the radical,

$$2V = 2\log_{10}\frac{0.70+1.23+1.01}{0.70+1.23-1.01} = 1.004.$$

According to Fig. 1, $2V = 1.00$.

If D is large compared with r_1, formula (6) becomes

$$2V = -4Q\log\frac{D+r_1}{r_1}. \qquad (7)$$

The use of the other sign of the radical in formula (6) merely changes the algebraic value of the potential but not its arithmetical value.

CAPACITY OF TWO STRAIGHT PARALLEL CYLINDRICAL CONDUCTORS

The capacity of two straight parallel cylindrical conductors in any medium of specific capacity k is

$$C = \frac{kQ}{2V},$$

where $2V$ is the potential difference between the conductors. Substituting formula (6)

$$C = \frac{k}{4\log\frac{r_1+\frac{D}{2}+\sqrt{\frac{D^2}{4}+r_1^2}}{r_1+\frac{D}{2}-\sqrt{\frac{D^2}{4}+r_1^2}}} \text{ electrostatic units.}$$

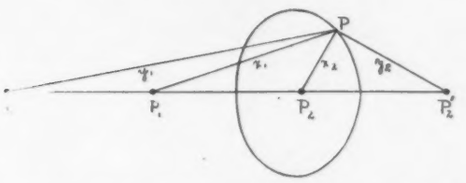


FIG. 7—METHOD OF CONSTRUCTING EQUIPOTENTIAL SURFACES WITHIN A TWO-CONDUCTOR CABLE

CAPACITY OF A TWO-CONDUCTOR CABLE WITH GROUNDED SHEATH

As is well known, a problem of this kind is generally solved by the method of "electrical images," which was devised by Lord Kelvin.‡ Because Lord Kelvin and others applied the method to charged spheres and similar problems only, it is necessary to adapt the method to the case of linear charges.

Let P_1 and P_2 (Fig. 5) represent two parallel conductors of infinitesimal cross-sectional area. Let $+Q_1$ and $-Q_2$ ($Q_1 = Q_2$ numerically) be the charges per unit length of P_1 and P_2 respectively. At P_1' let us suppose there is another infinitesimal conductor, charged with $-Q_1$ units of electricity per unit length. With O, the point midway between P_1 and P_2, as a center, describe a circle LMN with radius a. The distances $P_1'O$ and a are defined by the inverse point relation, i. e., $P_1'O \times P_1O = a^2$. The equipotential surfaces for P_1 and P_1' can now be drawn according to the method illustrated by Fig. 1 or by means of equations (3) and (4). It is evident that one of the surfaces, $V = 0.30$ in Fig. 6, will coincide with LMN. In the same manner one can find the equipotential surfaces for P_2 and P_2', where P_2' bears the same relation to P_2 that P_1' bears to P_1. One of these surfaces, $V = 0.30$ in Fig. 6, will coincide with LMN. The two surfaces which coincide with LMN and consequently coincide with each other are of opposite sign because the charges at P_1 and P_2 are of opposite sign; hence LMN represents an equipotential surface at zero potential. A thin conductor may be made to coincide with LMN and the equipotential surfaces will remain unchanged. If this conductor is grounded, the wires P_1' and P_2' together with their charges may be removed and the equipotential surfaces within LMN will remain unchanged. If LMN be supposed to represent the inside surface of a cable sheath, then the equipotential surfaces due to the grounded cable sheath and the two conductors P_1 and P_2 may be obtained by combining the sur-

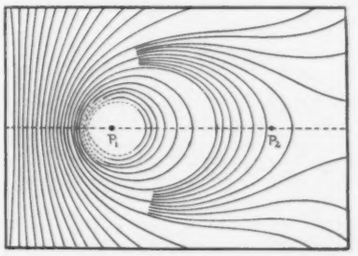


FIG. 8—EQUIPOTENTIAL SURFACES WHEN THE IMAGE CHARGE IS DISTORTED IN MAGNITUDE AND POSITION

‡See Chapter XI, Vol. I, "Electricity and Magnetism," by Clerk Maxwell.

faces due to P_1 and P_1' with those due to P_2 and P_2'. This is done in Fig. 6, where a number of surfaces around P_2 are drawn with heavy lines. The surfaces around P_1 are not drawn, but would be similar to those around P_2. Now, any surface such as $V = -0.30$ around P_2 and the corresponding surface $V = +0.30$ around P_1 can be replaced with conductors charged with $-Q_2$ and $+Q_1$ units of electricity respectively, the charges at P_2 and P_1 being withdrawn, and the equipotential surfaces between the conductors and the sheath will remain unchanged. Hence, if the inside surface of a cable sheath coincided with the circular equipotential surface $V = 0$, and the two conductors coincided with the surfaces $V = -0.30$ and $V = +0.30$, the difference of potential between the conductors could be obtained by the method of constructing Fig. 6. As constructed, $k = 1$, $Q_1 = 0.217$ electrostatic units, and the potential difference between conductors is 0.60 electrostatic units. If k were taken greater than unity, the potential difference of the conductors would have been equal to $0.60 \div k$.

The capacity of this cable per unit length is equal to

$$C = \frac{kQ}{V} = \frac{k \times 0.217}{0.60} = k \times 0.362 \text{ electrostatic unit.}$$

By reference to Fig. 6, it will be seen that some of the resultant equipotential surfaces are nearly circular in cross-section while others depart very much from the circular form. Furthermore, the equipotential surfaces which are nearly of circular cross-section are not concentric with P_2 or P_1.

An equation for the resultant equipotential surfaces in Fig. 6 can be easily derived, but the equation is not in a form which is easy to use. The potential at any point in Fig. 6 is equal to the algebraic sum of the potentials due to P_1 and P_1' considered as one system and P_2 and P_2' considered as a second system. If these two potentials are V_1 and V_2 respectively, then the potential at any point is equal to (see Fig. 7)

$$V = V_1 + V_2 = 2Q \log \frac{x_1}{y_1} - 2Q \log \frac{x_2}{y_2}$$

$$= 2Q \log \frac{x_1}{y_1} \div \frac{x_2}{y_2},$$

where the charge per unit length of P_1 is $+Q_1$ units and that on P_2 is $-Q_2$ units ($Q_1 = Q_2 = Q$ numerically). Or

$$\frac{x_1 y_2}{y_1 x_2} = \log^{-1} \frac{V}{2Q} = R = \text{a constant.}$$

$$\frac{x_1}{y_1} = R \frac{x_2}{y_2} \tag{7}$$

For $V = 0$, i. e., for $R = 1$

$$\frac{x_1}{y_1} = \frac{x_2}{y_2} \tag{8}$$

But it has already been shown that the equipotential surface for

$$\frac{x_1}{y_1} = \text{a constant} = \frac{x_2}{y_2}$$

is a circle. Hence equation (8) represents an equipotential surface, $V = 0$, which is circular in cross-section. Although the general equation (7) will give any of the equipotential surfaces, it is not in a form that renders computation easy.

While the foregoing theory will enable one to design a two-conductor cable of circular cross-section having a homogeneous dielectric, it does not lend itself to the computation of the potential difference of the conductors, and hence to the computation of the capacity of a cable which is already made. Clerk Maxwell has well said: "It appears, therefore, that what we should naturally call the inverse problem of determining the forms of the conductors when the . . . potential is given is more manageable than the direct problem of determining the potential when the form of the conductors is given."

The capacity of a cable constructed after Fig. 5 is, of course, equal to

$$C = \frac{kQ}{V}$$

where k is the specific capacity of the dielectric, Q is equal numerically to the charge per unit length of P_1 or P_2 and V is the difference of potential of two equipotential surfaces in Fig. 6 (those around P_1 are not drawn), which is constructed with k = unity for convenience.

In Fig. 5, P_1' and P_2', with their charges $-Q_1$ and $+Q_2$, may be called the "electrical images" of P_1 and P_2 in the sheath, the inside surface of which coincides with LMN. In this case the "image" charge was taken equal to the "object" charge and the distances $P_1'O$ and P_1O were related to a by the inverse point relation. Obviously neither of these conditions need be fulfilled, and figures not at all like Fig. 6 might result. In Fig. 8 are shown several equipotential surfaces which result from charges spaced as in Fig. 5 but with the "image" charge taken as numerically equal to the "object charge" multiplied by $a \div P_1O$. This value was chosen at random, being suggested by the fact that it is the proper value to assume with point charges in order to fulfil the "image" relation in a spherical conductor. The equipotential surfaces for P_1 and P_1' are shown in Fig. 9, P_1' being situated to the left of P_1 and not shown in the figure. Obviously the equipotential surfaces for P_2 and P_2' are correctly pictured by inverting Fig. 9 and assuming P_1 to represent P_2. These two sets of equipotential surfaces can be combined to produce those shown in Fig. 8. The cross-section of the inside surface of the resulting cable sheath, corresponding to $V = 0$ in the figure, is seen to be approximately elliptical in form. The other equipotential surfaces approach the circular form but are not concentric about P_1 and P_2. Fig. 8 is obviously not suited to cable design because if the conductors are supposed to coincide with the equipotential surfaces, $V = +20$ and $V = -20$ say, the dielectric between the two conductors is far thicker than twice that between conductor and cable sheath.

Conclusions

The theoretically exact formula for the capacity of a two-wire transmission line, as deduced above, is

$$C = \frac{1}{4 \log \dfrac{r_1 + \frac{D}{2} + \sqrt{\frac{D^2}{4} + r_1^2}}{r_1 + \frac{D}{2} - \sqrt{\frac{D^2}{4} + r_1^2}}}$$

where C is the capacity in electrostatic units of one centimeter length of conductor, D is the distance between centers of conductors and r_1 is the radius of either conductor. The usual formula is

$$C = \frac{1}{4 \log \frac{D - r_1}{r_1}}.$$

Reducing both formulas to microfarads per 1000 ft. of conductor and changing to logarithims having the base 10, the formulas become

$$C = \frac{0.003677}{\log_{10} \dfrac{r_1 + \frac{D}{2} + \sqrt{\frac{D^2}{4} + r_1^2}}{r_1 + \frac{D}{2} - \sqrt{\frac{D^2}{4} + r_1^2}}} \tag{9}$$

and

$$C = \frac{0.003677}{\log_{10} \frac{D - r_1}{r_1}}.$$

The error introduced by using the second formula when

the conductors are large and near together has already been illustrated. When the conductors are small and relatively far apart, the second formula is not much in error, though a better form for it is

$$C = \frac{0.003677}{\log_{10} \frac{D}{r_1}}. \qquad (10)$$

For example, consider No. 0000 B. & S. round wire spaced 6 ft. apart. According to formula (9), the capacity is equal to 0.00147 microfarads per 1000 ft., and according to formula (10) it is equal to 0.00147 microfarads. The error is too small to be calculated on the slide rule. However, the second formula must not be assumed to hold when D is not large with respect to r_1. It could not be expected to hold in the case of wires close together as in a cable.

Since the formula for the capacity of a three-phase, three-wire transmission line, with wires situated at the vertices of an equilateral triangle, is based directly upon the formula for a single-phase line, the necessary correction for the three-phase formula can be obtained directly from equation (9).

The capacity of a two-conductor cable with grounded sheath can be arrived at by means of the method used in connection with Fig. 6. Referring to this figure, it will be seen that the equipotential surface $V = -0.50$ around P_2 is nearly circular in cross-section and is nearly concentric about P_2. The constants of Fig. 6 may be used to calculate

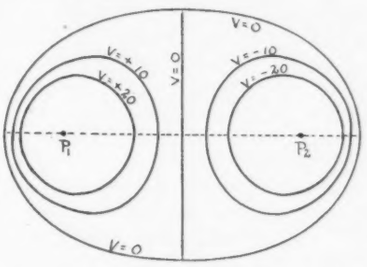


FIG. 9—EQUIPOTENTIAL SURFACES WITHIN A TWO-CONDUCTOR CABLE HAVING AN ELLIPTICAL SHEATH

the capacity of a two-conductor cable in which the inside of the sheath coincides with the circular equipotential surface $V = O$, and the two conductors of which coincide with the equipotential surface $V = -0.50$ around P_2 and the corresponding surface around P_1. The difference in potential of the conductors is then $V = 1$ electrostatic unit when the conductors are charged one with $+0.217$ and the other with -0.217 electrostatic units of electricity. The capacity is then

$$C = \frac{Q}{V} = \frac{0.217}{1.000} = 0.217$$

electrostatic units per centimeter length of cable. This result is based upon the supposition that the specific capacity of the dielectric is unity. If the specific capacity were equal to k, the capacity would be k times the value above.

According to the usual formula, the capacity is

$$C = \frac{0.003677k}{\log_{10}\left[\frac{D}{r_1}\left(\frac{a^2 - \frac{D^2}{4}}{a^2 + \frac{D^2}{4}}\right)\right]}$$

microfarads per 1000 ft. of cable. As drawn to scale, the constants of Fig. 6 are: $k = 1$, $D = 4$, $a = 4$ and $r_1 = 0.725$. Substituting these constants, $C = 0.00721$ microfarads per 1000 ft. of cable. To compare with the value 0.217 electrostatic units of capacity per centimeter of cable it is necessary to change this value to microfarads per 1000 ft.; the result is 0.00735 microfarads per 1000 ft. The difference between the two values is not of importance, and shows that the unequal distribution of the charge about the surface of the conductor is not so great in a two-conductor cable as it would be in a two-conductor transmission line of the same size of wire and spacing. But, from Fig. 6, it is evident that if larger circular conductors are placed in the same sheath, the usual formula could not be expected to hold because the surfaces of the conductors would not correspond to the equipotential surfaces. To compute the capacity from the constants of Fig. 6, the conductors would have to be of cross-section far from circular. To compute the capacity of a cable in which the conductors are of circular cross-section and large—that is, occupy most of the space within the cable sheath—is probably impossible at the present time.

Federal Permit for Power Development on the Pend d'Oreille

On July 29 the Secretaries of the Interior and of Agriculture jointly in behalf of the government issued a permit to the International Power & Manufacturing Company, of Spokane, Wash., granting the right to construct and operate a large hydroelectric undertaking on the Pend d'Oreille River, otherwise known as Clark's Fork, in the State of Washington, and situated on the public domain. The permit itself is an elaborate document, an abstract of the leading features of which is presented in what follows. Literally the permit covers the use and occupancy of certain lands of the Department of the Interior and in the national forests, said use and occupancy, however, being necessary for the construction of the works, part of which—the dam—had already been authorized by Congressional act. Certain provisions as to state regulation and the use of the lands in connection with any unlawful trust, and an agreement that the lands and permit shall be considered as of no value in respect to sale of the property or to regulation, follow closely those contained in the transmission line permit to the Great Falls Power Company, abstracted in the *Electrical World* of Feb. 8. The permit is indefinite as to period, but revocable, after due notice and hearing, for violation of the terms thereof. The most novel features of all relate to the fixing of maximum rates for energy and the compensation to be paid to the government. The Secretary of the Interior states that at lowest stages the stream flow is sufficient for the development of about 120,000 continuous hp and by use of storage facilities upon the stream above 350,000 hp can eventually be developed during years of low precipitation.

Among the definitions set forth in Section 1 of the permit, the following are of special interest:

"Nominal stream flow" means the sum of (a) the average of the values estimated for the mean natural flow for the two-month (calendar) minimum-flow period in each successive five-year cycle or major fraction thereof, and (b) the increase in such average due to artificial means other than the project works.

"Project storage flow" means the estimated increase in nominal stream flow made practicable by the project works.

"Available stream flow" means the sum of nominal stream flow and project storage flow.

"Total capacity of the power site" means the power estimated to be available for transmission, and is determined as the continued product of (1) the factor 0.08; (2) the average effective head, in feet; (3) the available stream flow at the intake (in cubic feet per second and in amount not to exceed the maximum hydraulic capacity of the project works), and (4) a factor, not less than the average load-factor of the power system, representing the degree of practicable utilization of the available stream flow, and based on the extent of practicable forebay storage and the load-factor of the system.

Respecting the compensation to be paid for the privilege, the power company will be required to pay nothing prior to the year 1923, but on or before the first day of February in each year, beginning with 1924, the permittee shall pay an amount calculated from the total capacity of the power site at rates per horse-power per year varying directly as the square of the average price for electric energy charged to customers and consumers of the permittee and varying inversely as the square of the proportional development of the power site, as shown by the accompanying table:

When the average price in cents per kilowatt-hour charged by the permittee is as shown by this column.	If the percentage of development of power site is—						
	Over 90	90 and over 80	80 and over 70	70 and over 60	60 and over 50	50 and over 40	40 or less
	Then the rates of compensation to the United States per horse-power per year will be as shown below						
0.2 and less	$0.05	$0.06	$0.08	$0.10	$0.14	$0.20	$0.31
0.3 and over 0.2	0.11	0.14	0.18	0.23	0.31	0.45	0.70
0.4 and over 0.3	0.20	0.25	0.31	0.41	0.56	0.80	1.25
0.5 and over 0.4	0.31	0.39	0.49	0.64	0.87	1.25	1.95
0.6 and over 0.5	0.45	0.56	0.70	0.92	1.25	1.80	2.81
0.7 and over 0.6	0.61	0.76	0.96	1.25	1.70	2.45	3.82
0.8 and over 0.7	0.80	0.99	1.25	1.63	2.22	3.20	5.00
0.9 and over 0.8	1.01	1.25	1.58	2.06	2.81	4.05	6.33
1.0 and over 0.9	1.25	1.54	1.95	2.55	3.47	5.00	7.81
1.2 and over 1	1.80	2.22	2.81	3.67	5.00	7.20	11.25
1.5 and over 1.2	2.81	3.47	4.40	5.74	7.82	11.25	17.60
2 and over 1.5	5.00	6.17	7.82	10.00	13.80	20.00	31.25
3 and over 2	11.25	13.87	17.58	22.95	31.25	45.00	70.40
4 and over 3	20.00	24.70	31.25	40.80	55.60	80.00	125.00
5 and over 4	31.25	38.60	48.80	63.80	86.80	125.00	250.00
6 and over 5	45.00	55.60	70.40	91.80	125.00	180.00	281.25

At any time not less than ten years after the date for the first payment or after the last revision of the rates of compensation the Secretaries of the Interior and Agriculture may review such rates after application by or notice to the permittee and impose such new rates of compensation as they may decide to be reasonable and proper, provided that such rates shall not be so increased as to result in reducing the margin of income (including appreciation in land values) from the project over proper actual and estimated expenses (including reasonable allowance for renewals and sinking-fund charges) to an amount which, in view of all the circumstances (including fair development expenses and working capital) and risks of the enterprise (including obsolescence, inadequacy and supersession), is unreasonably small; but the burden of proving such unreasonableness shall rest upon the permittee.

Complete development of the power site shall mean the construction of such permanent project works and the installation of such generating equipment as will provide for the full utilization of the total capacity of the power site.

The project works as a whole, excepting installation of hydraulic and electric machinery, shall be begun within one year and completed within three years. Machinery of 50,000-hp rating shall be installed within three years, and additional machinery shall be installed as the conditions of the market will warrant or as the Secretaries or any duly authorized State agency may direct.

The average price for electric energy charged to customers and consumers of the permittee shall be determined by dividing the total actual and estimated annual receipts from the sale and disposition of electric energy by the total number of kilowatt-hours generated, provided that in determining said total annual receipts there shall be included estimated receipts for any electric energy used by the permittee at a price which shall not be less than 2 cents per kw-hr. nor less than the cost per kilowatt-hour of generating, transmitting and delivering such energy to the point of use, taking into account proper operating and maintenance expenses, fixed charges and reasonable allowances for renewals and sinking fund.

Unless otherwise authorized by the Secretaries of the Interior and Agriculture, the maximum price at which electric energy developed by or transmitted from the power project may be disposed of to customers or consumers shall not exceed 6 cents per kw-hr., and the maximum price at which such electric energy in excess of 2000 kw-hr. per annum with an average annual delivery of more than 35 per cent of the connected installation within the year may be disposed of to customers or consumers shall not exceed 2 cents per kw-hr., said maximum price being determined by dividing the total annual charge to the purchaser by the corresponding total annual delivery to him of electric energy. In contracts with its customers the permittee shall specify the maximum price of final sale or resale and shall reserve the right to cancel any contract or agreement for sale or resale of electric energy that provides for a price in excess of such maximum. No more than 50 per cent of the total deliverable capacity of the power site shall be delivered to any one consumer. The total capacity of the site shall be deemed and taken to be 112,000 hp, but is subject to adjustment by the Secretaries annually to provide for increase or decrease, by storage or otherwise, of available stream flow to an amount of 10 per cent or more, or for increase or decrease of 10 per cent or more in average effective head, or in degree of practicable utilization.

The permittee is, upon demand in writing by the Secretaries, to surrender the permit to the United States or to transfer the same to such state or municipal corporation as the Secretaries may designate, and to sell or transfer with the permit all property then owned or held by the permittee on lands of the United States and then valuable or serviceable in the generation, transmission and distribution of energy, provided (a) that such transfer shall not be demanded in the case of a municipal corporation unless by condemnation such corporation shall have acquired, or unless by proceedings in a court of competent jurisdiction it shall have been determined that such a municipal corporation has the right to acquire, the property of the permittee situated elsewhere than on public land, or unless such municipal corporation has the power to acquire the property and rights of the permittee in accordance with the following conditions: (b) that such surrender or transfer shall be on condition precedent that the United States shall pay or the transferee shall first pay to the permittee the reasonable value of all such works and property to be surrendered or transferred; (c) that such reasonable value shall not include any sum for any permit, right, franchise or property granted by any public authority in excess of the sum paid to such public authority as a purchase price therefor, and (d) that such reasonable value shall be determined by mutual agreement of the parties in interest, and in case they cannot agree, by the Secretaries under a rule which, except as modified by the requirements of this section, shall be the then existing rule of valuation for power properties in condemnation proceedings in the State in which the properties to be surrendered or transferred are located. But nothing herein shall prevent the United States or any state or municipal corporation from acquiring by any other lawful means the permit or the works or property then owned or held by the permittee on lands of the United States occupied or used under the permit.

No value whatsoever shall at any time be assigned to or claimed for the permit or for the occupancy or use of Interior Department lands or national forest lands thereunder, nor shall the permit or such occupancy or use ever be estimated or considered as property upon which the permittee shall be entitled to earn or receive any return. The power company is also enjoined from entering into any unlawful restraint of trade or competition. It is further agreed that at intervals of not less than twenty years, on application of the permittee or on demand of the Secretaries, this agreement and the permit shall be modified to conform to the then subsisting regulations fixed by the Secretaries under the act of 1901 or amendments thereto.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

"Iron by Wire"

Advertising electric flatirons, the Union Electric Light & Power Company, of St. Louis, adopts the rather striking slogan "Iron by wire." It is declared that an electric iron can mean more to the health, comfort and happiness of the home than any other one thing. On request an electric iron will be loaned for thirty days' free trial. One point is that "nothing gets hot but the iron." The price made is $3.50, and the irons (except cords) are unconditionally guaranteed to customers, with no time limit.

Electric Pumping for West Springfield, Mass.

Hydroelectric energy supplied from the transmission lines of the Amherst Power Company will supersede steam and gasoline engine service on Sept. 1 at the Bear Hole pumping station of the West Springfield (Mass.) water-works. Two General Electric motors of 275 hp combined rating will be installed. The contract for the work, which has been awarded to Mr. P. C. Fitzpatrick, of Springfield, Mass., includes a rearrangement of pumps and other station equipment to provide a more efficient service.

Fan Sales in St. Louis

Electrically lighted billboards bearing the display matter shown in the accompanying illustration, coupled with a special appliance campaign and the necessary hot weather to make it effective, resulted in the largest electric fan sale which the Union Electric Light & Power Company, St. Louis, has had in years. Fig. 1 shows one of the electrically lighted billboards. There were 715 linear feet of these boards used to advertise the comforts of an electric fan during the otherwise unbearably hot days which have prevailed over this country during the greater part of the summer. The boards range from 30 ft. to 40 ft. in length.

Mr. Charles E. Michel, manager of the new-business department of the company, reports that during the last week in June and the first week in July 50 per cent more electric fans were sold than during the entire previous year. The fan campaign was really started on June 25, when the new-appliance room was opened to the public. On that day a 10 per cent discount was offered on everything. During the two weeks mentioned 842 fans were sold, having an aggregate consumption of 55,796 watts. The money paid for the energy consumed by these fans represents a considerable increase over the regular revenue. The fans ranged in diameter from 8 in. to 16 in., most of them having oscillating attachments.

FIG. 1—ADVERTISEMENT ON ELECTRICALLY LIGHTED BILLBOARD

Fig. 2 is a view of the new-appliance room, in which fans and other conveniences made possible by electricity

FIG. 2—NEW-APPLIANCE DISPLAY ROOM

are displayed. The room is lighted by six "brascolite" fixtures, each containing a 250-watt tungsten lamp. This type of lighting has cut down the energy consumption by one-half from what it was when the room was illuminated by direct lighting and has increased the illumination at 3 ft. above the floor from 3.9 to 8.5 ft.-candles. The wall cases and show cases are made of selected quarter-sawed oak lined with black broadcloth. The interior of these cases is lighted by lamps inclosed in semi-cylindrical reflectors arranged horizontally. The compartments below the wall cases are used to store appliances wrapped in cartons.

Central-Station Improvements at Greenfield, Mass.

The Greenfield (Mass.) Electric Light & Power Company has lately effected a number of improvements in its generating and distributing system which go far toward strengthening the company's position in the north-central portions of the State. A 2000-kw Curtis steam turbine costing about $30,000 has been installed in the main steam plant at Greenfield, with two Porcupine boilers, rated at 500 hp each, at a cost of $11,500. The condensing-water supply formerly pumped into the station has been rearranged to permit its introduction by gravity, and an addition of two 1170-kva waterwheel-driven generators with S. Morgan Smith turbines is being made to the equipment of the company's hydroelectric station at Gardners Falls, on the Deerfield River. The company has erected a transformer station in Barnardston and is distributing energy at 2300 volts there and in the town of Northfield. The river channel below Gardners Falls station has been deepened to supply additional head. A new dam is shortly to be built on the Green River, in Greenfield, to maintain an ample supply of condensing water, and a small water-power is to be developed at this point for supplementary service. The Gardners Falls plant originally contained two

400-kw generators, but, following the developments of the New England Power Company on the Deerfield River described in the Dec. 28, 1912, issue of the *Electrical World*, the opportunity to develop additional power was recognized.

The new equipment of the Gardners Falls station includes two 1450-hp turbines designed to operate at 150 r.p.m. under 37 ft. working head and an exciter turbine of S. Morgan Smith make, rated at 135 hp, the cost of these erected being $11,500, or $3.85 per hp. The electrical apparatus consists of two generators of 1170 kva rating, a 60-kw exciter and three 1200-kva, three-phase transformers for delivering energy at 13,200 volts to the Greenfield company's transmission feeders, the price of this equipment f.o.b. factory being $29,500. The estimated cost of switchboard additions for this installation is about $15,000, including incidentals, and the contract for excavation, extending the station and installing foundations is figured at $4,250.

In a recent statement, Mr. Philip Cabot, vice-president of the company, pointed out its strategic position with reference to neighboring developments and discussed its operating features from the standpoint of economical production. The company purchases surplus energy from the hydroelectric plant of the Turners Falls Power Company at a price of about 0.5 per kw-hr., or less than the cost of coal landed at the Greenfield station. As a result of the use of this exclusive energy and that from Gardners Falls throughout about two-thirds of the year the cost of energy to the Greenfield company is lower than in many other plants in the State doing a larger business. For the calendar year 1912 the company's water-power plant output was 4,080,800 kw-hr.; its steam-plant production was 624,020 kw-hr. and it purchased 3,062,900 kw-hr. The total costs of operation per kw-hr. were: Manufacturing, 6.6 mills; distribution, 4.8 mills; general expense, 2.6 mills; overhead charges, 8.2 mills, the total expense being 2.22 cents per kw-hr. The average revenue per kw-hr. from sales for motor service was 1.76 cents; from commercial lighting, 12.3 cents; public lighting, 5.6 cents; sales to other companies, 2.4 cents. Mr. Cabot further pointed out that the operation of the hydroelectric plants at Turners Falls and Gardners Falls in connection with the steam turbine plants at Greenfield and Easthampton, including in the latter service supplied by the Amherst Power Company, permitted advantageous load-factors to be enjoyed under centralized direction.

Free Flatiron with Wiring Contract

It is the practice of the Public Service Company of Northern Illinois to give an electric flatiron free to every householder adjacent to its lines who signs a contract for the wiring of his house. Mr. John G. Learned, of that company, reports for the first half of this year 800 contracts for the wiring of old houses, compared with 350 for the corresponding period of last year. Before 1913 the company had never wired more than 1200 houses in one year, but it has set its mark for 2000 for this year. Each of these new customers will have a flatiron as part of his load.

Free Fan Service for the Sick

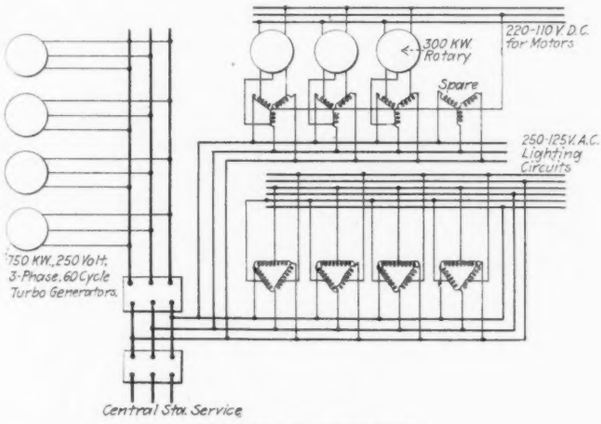
The policy of giving free fan service to the needy sick, which originated with the Rochester (N. Y.) Railway & Light Company some years ago, has been very extensively adopted throughout the country. One of the latest companies to place it in effect is the Kentucky Utilities Company, a subsidiary of the Middle West Utilities Company, which has offered free electric fan service for the remainder of the summer to every sick person who is unable to pay for the service and whose residence can be reached from its existing distributing lines. In order to protect itself against imposition, the company requires its local managers to obtain a physician's statement certifying the necessity of such fan service and also the patient's inability to pay for it. The physician is also instructed to notify the local manager when the necessity for the service ceases.

If the house is not wired, the company will run service wires and install sufficient wiring to operate the fans, loaning the latter to the patient as long as, in the judgment of the physician, may be necessary. Energy for operating the fans is also supplied gratis. The offer applies only to the towns in which the company is supplying twenty-four-hour service and where the service lines can be installed without extending the distributing lines.

As the use of an electric fan greatly improves the condition of a patient whose vitality is reduced by the extreme heat of the summer months, and sometimes represents the narrow margin between life and death, this generous offer has been very effective in securing the good will of the community in which the electric service is available.

Electric Service for Large Office Building Controlled from Another Building a Block Away

Because space in the new Railway Exchange Building in St. Louis is so very valuable, all feeder switching apparatus is installed in the basement of another building in an adjoining block. Electrical energy will be secured from an isolated plant and also from the Laclede Gas Company of St. Louis. The isolated plant is in the same basement as the feeder switchboard and will be operated by the Light


300 KW. Rotary
220-110 V. D.C. for Motors
Spare
250-125 V. A.C. Lighting Circuits
750 KW., 250 Volt, 3-Phase, 60 Cycle Turbo Generators.
Central Sta. Service

CONTROL CONNECTIONS

& Development Company, of St. Louis. In a basement adjoining the isolated plant the Laclede company is erecting a substation. During the winter the isolated plant will furnish energy for a load of about 1800 kw, as well as the heat for the building, while from May 1 to Oct. 1 the energy will be purchased from the central-station company.

The isolated-plant generating equipment will consist of four 750-kw, 250-volt, three-phase, 60-cycle General Electric turbo-generators, which will receive steam from four 500-hp Heine boilers. A 600-ton concrete coal bunker into which coal can be unloaded through manholes in the sidewalk is provided, and an endless belt conveyor receives coal from chutes opening out of the bottom of the bunker and conveys its charge to 10-ton overhead hoppers. Ashes may be disposed of by means of small cars dumped onto telescoping sidewalk lifts, or by a vacuum ash-handling system, and loaded onto wagons.

The steam-turbine units supply energy at 250 volts to eight 300-kw, three-phase auto-transformers, four of which are delta-connected and supply energy for lighting circuits. Taps are provided in the middle of each leg of the delta for three-wire service, the middle taps being unfused, since

an unbalanced load on the three-wire system would cause lamps to burn out in case a fuse was ruptured. Busbars connect all of the 250-volt taps on these auto-transformers so that a tie switch may be used to connect with the central-station source of supply. The remaining transformers are star-connected and supply energy to three 300-kw rotary converters. The rotaries supply direct surrent at 250 volts for elevator service, and a tap from the neutral of the sets provides for 125-volt direct-current service.

Four 300-kw, 4150-250-volt, three-phase transformers are also installed in the basement and receive energy from the Laclede Gas Light Company's adjoining basement substation. The secondary terminals of these transformers may be connected onto the 250-volt alternating-current bus by a tie-switch when it is desired to change over from one source to the other.

Merit System for Central-Station Salesmen and Solicitors

A plan of remuneration of the sales force of the Union Electric Light & Power Company, of St. Louis, according to the merit system, has now been in force for about a year and the results obtained therefrom have proved very satisfactory. Operated in conjunction with the merit system there is a sales school, sessions of which are held every Saturday afternoon in the company's office building under the instruction of a faculty composed of three industrial graduate engineers, the assistant sales manager and Mr. F. D. Beardslee, sales manager. The purpose of the course is to familiarize the employees of the sales department with rate schedules and general terms and conditions of contracts, and also to ascertain what each man knows so that the proper one can be picked for certain duties.

Every employee of this department is assigned to one of the three classes, the attendance at which is compulsory. Class No. 1 is composed of new men and others whose understanding of the business is questioned. Class No. 2 is composed of men better posted in matters of salesmanship and rates pertaining to commercial lighting and small motor-service business. No. 3, the advanced class, is composed of industrial engineers and men who are familiar with all phases of the sales business of the company.

In class No. 1 the men are taught the fundamentals of rate-making, reasons for certain rates, and the application of rates to residential and ordinary commercial lighting and small-motor business. They are also drilled with reference to taking and handling business according to the company's handbook. In class No. 2 the student is taught the application of rates in the more complicated commercial lighting and medium-sized motor installations, receiving in addition some instruction in illuminating engineering. In class No. 3 discussions on various applications of electric drive to industrial purposes are taken part in, and rate schedules are applied to mixed lighting and motor installations. Lectures by engineers are given from time to time before this class.

Promotions are made from the different classes as soon as the student is able to pass the corresponding examination, which consists of twenty written questions and oral demonstrations on ability to sell electric service to one of the faculty.

The accompanying chart shows the scheme of paying the salesmen on an equitable basis. The plan is that the monthly salaries shall increase with each year's service with the company, thereby giving the older employees a higher salary, on the general theory that the longer a man stays with the company the more valuable his services become. On the other hand, a new man on a smaller salary, if more capable, may earn more by obtaining high merit points as indicated in the chart. To equalize the merit points which are received from different districts, sections of the city in which business is comparatively easy to obtain are labeled with handicaps. Each district has a specified minimum business determined from past records.

The sequence of promotion is in the order of residential, commercial and industrial service salesmen, but after ten years' employment it is considered that the men will be in a position to justify advancement to salaries which are not covered by this schedule. Errors are provided for by deducting merit points. As occasions demand the merit chart is revised. As the men progress from class No. 1 to class No. 2 they are considered as having advanced one year in the service of the company. A commercial chart is located in the salesmen's meeting room, on which the business which each salesman has done during the day is recorded, with the corresponding merit points. This bulletin is watched like a "baseball-return" board, and it inspires each man to surpass the others.

CHART OF MERIT SYSTEM OF PAYMENT FOR CENTRAL-STATION SALESMEN

PAYMENTS FOR MERIT

Commercial Salesmen		Residential Salesmen	
First	$40.00	First	$15.00
Second	30.00	Second	10.00
Third	20.00	Third	7.50
Fourth	10.00	Fourth	5.00
Fifth	5.00		

COMMERCIAL SERVICE SALESMEN—MERIT POINTS

For each new-business contract on office call (not additional)	3
For each new-business contract on personal call (not additional)	6
For each successor's contract	2
For each kw capacity, new business and additional	1
For each $100 estimated yearly revenue	3
For each $10 appliance sales	3
For each suggestion for good of the service which is adopted	10

RESIDENTIAL SERVICE SALESMEN—MERIT POINTS

For each new-business contract on office call (not additional)	3
For each new-business contract on personal call (not additional)	6
For each successor's contract	2
For each contract to wire old houses	10
For each kw capacity, new business and additional	1
For each $100 estimated yearly revenue	3
For each $10 appliance sales	3
For each suggestion for good of the service which is adopted	10

HANDICAPS AND MINIMUMS

Districts	1	2	3	4	5	6	7	8	9	10
Commercial:										
Handicaps	100	90	90	80	70	100	....	....	30	40
Minimums	200	190	190	180	170	150	100	100	130	140
Residential:										
Handicaps	80	100	50	50	30	....	60	30	....	....
Minimums	180	200	150	150	130	100	160	130	....	....

INDUSTRIAL SERVICE SALESMEN

Salaries based on efficiency and each salesman handicapped one point for each dollar of monthly salary. Merit points same as commercial-service salesmen.

Monthly payments for merit: First, $15; second, $10; third, $5.

APPLICATION AND LAMP COUNTERS, MAIN OFFICE AND BRANCHES

Salaries based on efficiency.

Merit points: For each $10 appliance sale, $3.

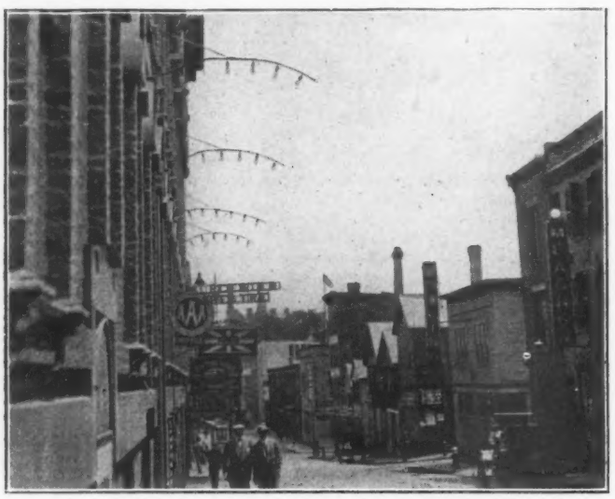
Monthly payments for merit: First, $5; second, $3; third, $2.

Note.—No merit payment will be made to any individual, unless he or she has obtained nine or more points during the month.

Illumination and Wiring

Special Sidewalk Lighting for Theater Approach

An effective method of calling attention to the shortest route to the playhouses is shown in the accompanying illustration of a special sidewalk lighting installation at Worcester, Mass., used by the Worcester Theater. The establishment is located on a side street and slightly below the main thoroughfare of traffic. To provide better illumination for patrons and to establish an avenue of light leading directly to the main entrance seven pipe-frame brackets were attached to the side walls of a hotel building bordering the passageway, each bracket being equipped with six 25-watt tungsten lamps with clear bulbs. The brackets are about 7 ft. long and are about 25 ft. apart, being from 15 ft. to 20 ft. above the sidewalk. The wiring is carried in conduit along the outer wall of the hotel, with fuse



ILLUMINATION FOR THEATER APPROACH

boxes at the individual brackets. The sidewalk is 7 ft. wide, and at the end of the row of brackets a large electric sign projects from the theater into the street, forming a climax in the perspective. Energy is supplied by the local central station.

Distribution Line Records—II

By H. A. Holmes

In last week's issue it was suggested that data on manholes, poles, etc., might be kept on cards instead of on drawings. Fig. 6 represents a series of 5-in. by 8-in. cards showing each manhole, the ducts occupied and the apparatus in the manhole. Manholes should be numbered on the decimal system. By doing so intermediate manholes or handholes can be inserted without disarranging the numbering scheme. For example, if Nos. 5 and 6 have been assigned to two manholes about 400 ft. apart and a handhole is placed about 100 ft. from No. 5, the number assigned to this would be 5.2. If two manholes were afterward installed between Nos. 5 and 5.2, they could be numbered 5.05 and 5.1. This subdivision may be carried as far as necessary. The four ruled squares grouped around the central square represent the side of the manhole laid down flat. They are ruled in squares so that the ducts can be easily outlined by following these lines. Their approximate point of entrance to the manhole can also be shown, and if transformers are installed in the manhole the location may be indicated by a circle drawn with water-color. The number of the transformer should be marked near it with water-color. The size and other data should be placed on the back of the card (Fig. 6a). Data on switches and branch or main fuses should also be recorded on the back of the card. If the dimensions given are entered on this card, it will often save reference to the drawings in Series No. 5. These dimensions should not be considered essential, however. In the system for which this card was designed the number of ducts in a row might increase to

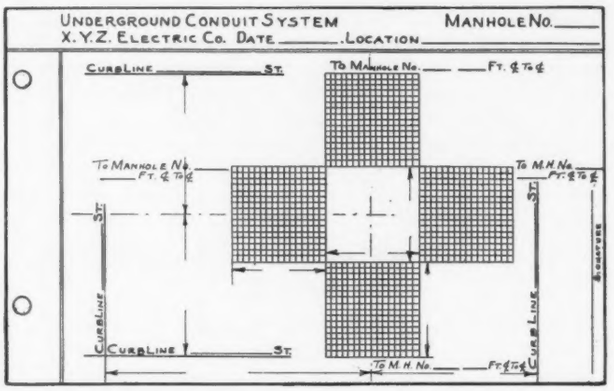

UNDERGROUND CONDUIT SYSTEM
X.Y.Z. ELECTRIC CO. DATE _____ LOCATION _____
MANHOLE NO. ____
CURB LINE ____ ST.
TO MANHOLE NO. ____ FT. & ____ ∠
TO MANHOLE NO. ____ FT. & ____ ∠
TO M.H. NO. ____ FT. & ____ ∠
CURB LINE ____ ST.
CURB LINE ____ ST.
CURB LINE
TO M.H. NO. ____ FT. & ____ ∠
CURB LINE

FIG. 6—MANHOLE RECORD CARD

sixteen. This made the size of the ruled squares so small that the number of the circuit could not be placed in the square corresponding to the proper duct. The occupied ducts are merely indicated by a dot. If it is known that the number of ducts will not exceed that many, the squares may be enlarged and this card may then render the use of the one shown in Fig. 7 unnecessary. The card should be filled in by the construction foreman and punched for his notebook. In this connection it may be suggested that all work orders, etc., be made on 5-in. by 8-in. cards and punched similarly for use in these notebooks. When properly filled in, the card is turned over to the engineering department for use as a guide for the inspector in obtaining data for the remaining series. It is possible that the construction foreman's order can be arranged so that the purpose served by Fig. 6 can be performed by it. If so, it would be unwise to duplicate his work by using the front of this card.

Fig. 7 represents a series of 5-in. by 8-in. cards showing a section between each two manholes. This card involves a system of numbering ducts. The following is suggested:

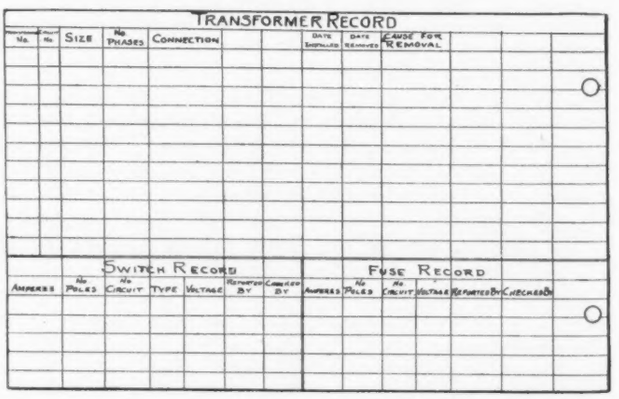


FIG. 6A—REVERSE SIDE OF CARD SHOWN IN FIG. 6

Stand so that you can look along the line of ducts and face either northeast, north, northwest or west and number the ducts from left to right beginning at the top. The only object of numbering the ducts is to enable an order to be sent to the construction department to pull cable in a certain duct or replace cable in a certain duct. As the method of showing the duct cross-section may not be clearly under-

stood, an instance has been shown in Fig. 7 where a system of ducts has been outlined and numbered. The other columns are self-explanatory. A line is used for each cable. The information "date removed" and "cause of removal" may not seem necessary to some, but if the column "date removed" were not supplied it would be necessary to cross out a line when a cable is removed. This confuses the record, and it is much neater and easier to insert a date which will supersede the record than to cross out a line of writing. The cause of removal may be interesting in noting the behavior of different classes of cable and the growth of business. It will also indicate whether sufficient allowance for increase in load is being made. It may be omitted without detracting from the efficiency of the record, however. The object in considering a section between manholes instead of each face of the manhole is that in the latter system there would be duplication of records. In the present system a section between two manholes will always be filed under the manhole with the lowest number of the two. For a pole line this card would be modified as shown in Fig. 7a. These cards and the following series, No. 8, are punched for insertion in the notebook of the inspector.

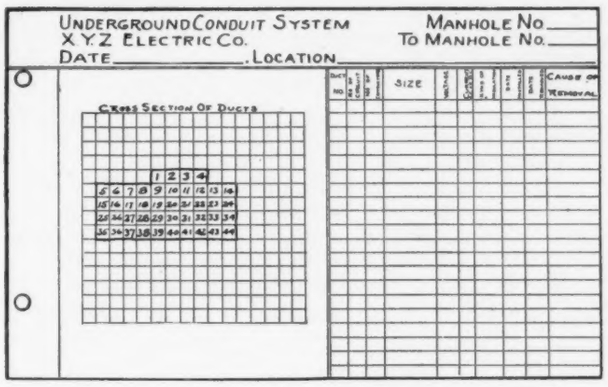


FIG. 7—CARD FOR SECTIONS BETWEEN MANHOLES

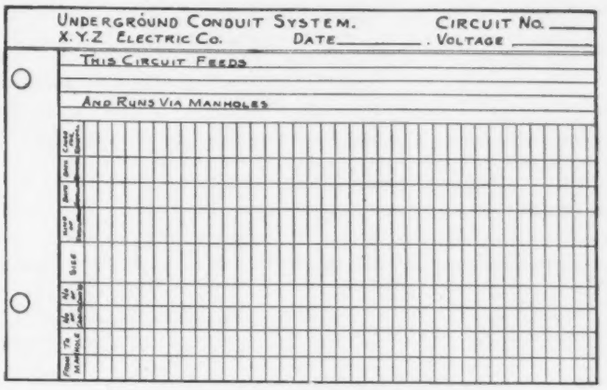


FIG. 8A—CABLE RECORD

Where the distribution system passes through several manholes or over several poles without change or taps, one

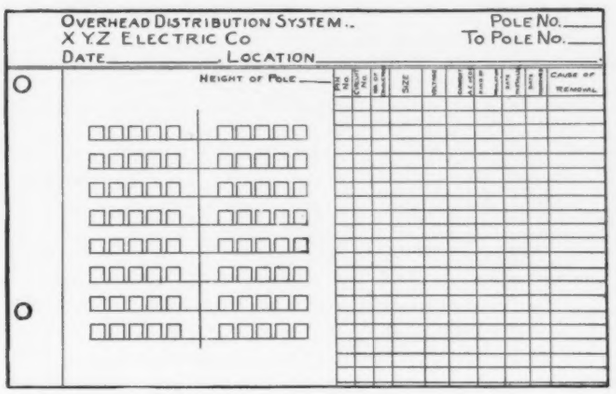


FIG. 7A—CARD FOR OVERHEAD POLE LINE

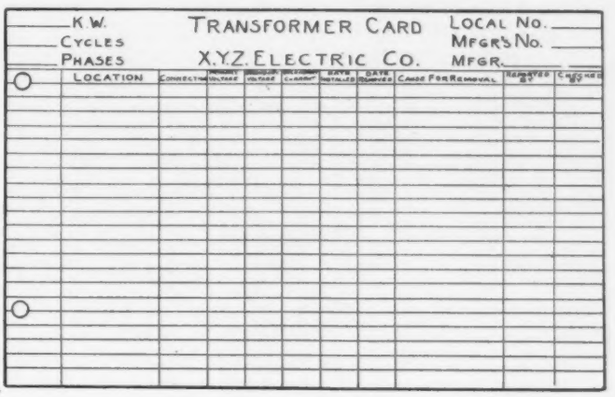


FIG. 9—TRANSFORMER RECORD CARD

card may represent the entire section until such time as a change is made.

Fig. 8 represents a series of cards somewhat similar to those of Fig. 7 with the cross-section omitted. If the lines on Fig. 7 become filled, the data are continued on these cards. The corresponding card for the pole line would be similar to the right-hand side of Fig. 7a.

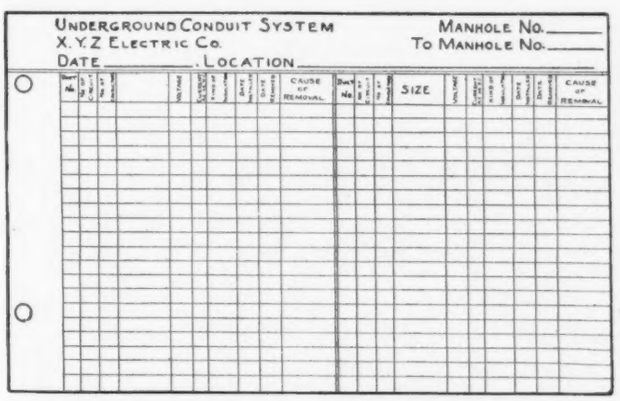


FIG 8—CARD FOR UNDERGROUND CONDUIT SYSTEM

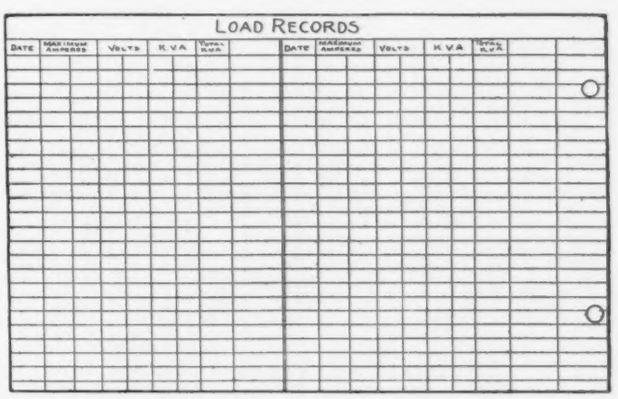


FIG. 9A—REVERSE SIDE OF CARD SHOWN IN FIG. 9

While somewhat separate from the distributing system proper the transformer is nevertheless one unit of it. A

card (Fig. 9) is therefore given for recording the data on transformers. This card gives the complete history of the transformer from the time of its receipt by the company. The column "cause for removal" on this card will show up any recurring trouble in the transformer. The column so headed in Fig. 6a will indicate trouble recurring on a particular circuit or in a particular manhole. The back of this card (Fig. 9a) should be used to record the tests made at peak and light load periods to determine when a larger transformer is needed or when transformers may be disconnected. It will be noted that columns for only two circuits or phases are given. If three-phase transformers are used, there should be space for readings on the third phase.

In installing this system the data would be obtained by inspectors assigned to the duty. They would necessarily have to obtain much of the information from the foreman of construction. If no data of this nature have previously been kept, it will be a long and tedious task to get information, but the accessibility of the information will more than justify its tabulation.

All new construction or changes in the underground system should be made by the construction department in accordance with drawings furnished by the engineering department under Series 5. If only a service duct and handhole are being installed, a small 8-in. by 10.5-in. drawing placed on an 8.5-in. by 11-in. sheet is sufficient. The blue print should be returned to the engineering department with notes showing any changes which were necessary because of underground structures not known to exist. The tracing should then be corrected.

If the change involves any change in the circuits, Series No. 1, 2, 3 or 4 should be corrected accordingly. This work of keeping the maps up to date should not be allowed to accumulate, as constant attention reduces the work to a minimum.

If a new manhole has been added or if the circuit or wire sizes have been changed, the construction foreman should return to the engineering department a card of Series 6 or his order giving the data called for thereon. If new wires only have been installed or the sizes changed, a dot in the proper duct with a note regarding the work is all that is necessary. The inspector should then verify the information turned in and correct or fill out the cards of Series 7 and 8.

Recent Telephone Patents

New Transmitters and Receiver

Early experiments showed carbon to have such excellent microphonic properties that for a long time it has been used extensively in transmitter manufacture. Mr. S. G. Brown, of London, England, has found what he considers an advantageous substitute in osmium iridium alloy as it occurs in nature. Its use is suggested either for a single contact or as granules. A United States patent has been granted to Mr. Brown for transmitting devices using this alloy.

Mr. Francis Kayser, of Philadelphia, has patented a unique type of transmitter for use in conjunction with desk-set telephones. The upright of the stand carries a carbon rod the upper end of which is secured to the diaphragm. The diaphragm must be integral with or have a fixed relation to the upright. The carbon rod is swung upon a horizontal pin near the diaphragm. The lower or long arm dips into a receptacle containing a stationary contact and a mass of carbon granules. The lever acts as a movable electrode and its motions control the resistance.

It is the object of Mr. A. Marr, of Manchester, England, to cut down the peripheral contact of the diaphragm of the telephone receiver. To accomplish this the diaphragm is clamped between two rings whose opposing faces have been oppositely beveled. The diaphragm is held between the rings which make line contact with it.

Letter to the Editors

Solution of the Telephone Trust Difficulty

To the Editors of the Electrical World:

Sirs:—The writer has noticed from time to time that your editorial department is perhaps inclined to complain of the attempts of the United States Department of Justice to regulate telephone traffic, and, in fact, has covered with a very thin veneer of courtesy its opinion of suits against other so-called trusts. The following facts are called to your attention:

Two telephones or more in a town are a needless annoyance and expense, but wherever you find both trust and independent telephones you find better service and cheaper rates. The problem, then, is to get the cheap service and cheaper rates without the needless expense, which is, perhaps, one cause of the high cost of living. This can be done by forcing telephone companies to interconnect. There is absolutely no reason, either legal, financial or technical, why there should not be a system of trunk lines connecting the offices of the different telephone companies so that the user of one telephone would be able to talk just as satisfactorily and freely with a subscriber on another line as with a subscriber on his own line.

Such a method would give competition pure and simple, would do away with the necessity of having two telephones, and would enable the company which gave the better service to have the greater number of subscribers.

Now, in regard to the suit against the American Telephone & Telegraph Company. You are probably aware that this company is perhaps one of the greatest companies restraining trade that there are in existence. You probably know that any one of the licensee Bell telephone companies could not purchase one cent's worth of material without buying from the Western Electric Company (company store). This, of course, is a legal method of doing business, but it is a dishonest one for the reason that the owners of the company store charge high prices for the material, supplies and apparatus which they sell, thereby robbing the minority stockholders of the licensee telephone companies just as surely as if they met them on some dark street some night and rifled their pockets. This is proved by the fact that the identical apparatus which the licensee companies are forced to purchase through the company store is sold for export at less prices than to the American companies.

I sincerely believe that the Department of Justice and the Interstate Commerce Commission are doing nothing whatever to injure business in any way; that they are not causing a nerve-racking ferment; that there is no hysteria caused by the spirit of the Sherman act; that people who say that Congress should be forgotten for ten years could be put in jail on general principles and the country would never miss them.

Minneapolis, Minn. R. L. Lunt.

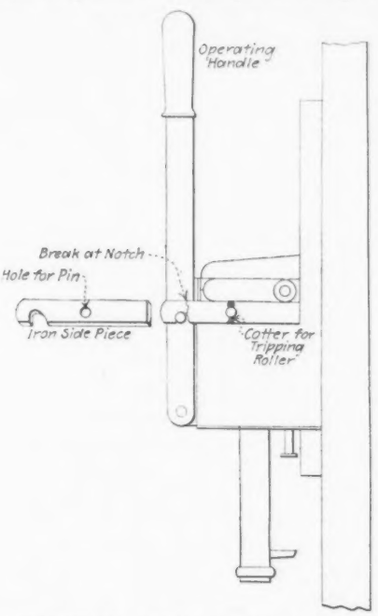
[The tone of our correspondent's letter is a very good example of the hysteria to which we referred in the article of Aug. 2 on the telephone suit. Legally it is not an easy matter to effect such an interchange of telephone traffic as he proposes. The public gets a large measure of relief through consolidation of plants under commission control. Regulation of rates and service by public authorities is the answer of society to the tendency in this country toward monopoly. It does not help in working out this solution for critics like Mr. Lunt to speak of the objects of their attacks as riflers of people's pockets. If Mr. Lunt will re-read our comments on the telephone suit, he will notice that we did not criticise the Department of Justice or the Interstate Commerce Commission in the least. On the contrary, we pointed out that they were merely doing their duty. We did criticise the American people for an anomalous condition created by conflicting statutes.—Eds.]

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Temporary Repair to Oil Switch

The accompanying sketch shows the temporary repair made on a circuit-breaker operating handle which had broken down at the catch notches designed to hold the handle in the closed position. Side blocks were accordingly made the same shape as the notch parts, using flat pieces of



TEMPORARY REPAIR TO OIL SWITCH

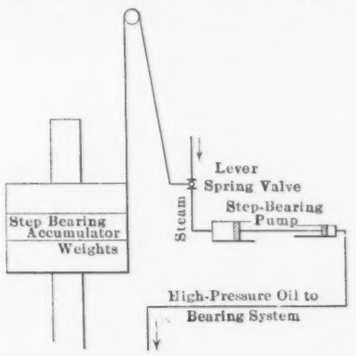
iron. These side pieces were then fixed in place by the cotter pins which hold the tripping roller inside. The job cost little to carry out, and will keep the oil switch in operation until a new casting can be secured.

Accidents and Their Prevention

One feature of the useful safety bulletin issued monthly by the department of safety, sanitation and relief of the Inland Steel Company of Chicago is a department entitled "Accidents and Their Prevention." Here are mentioned briefly some accidents that have happened in the works at Indiana Harbor with a few words of warning. Thus, a laborer was screwing an electric lamp in a socket when it exploded and he was burned by the flash. The moral is thus expressed: "Turn off power before screwing lamp globes in sockets. Laborers and all persons not authorized should not meddle with electrical apparatus. Call an electrician." Again, an electrician who was splicing wires was burned by a flash. This gives occasion for the following admonition: "Don't work on live wires unless absolutely necessary, and then take necessary precautions for safety." The little pamphlet contains condensed and attractively presented information about various methods of safety in industrial works, as the guarding of gears, the operation of machinery, instructions as to first aid to the injured and the like. Prizes are offered for safety suggestions. Mr. J. C. Smith is the safety inspector of the company.

Automatic Control of Step-Bearing Pumps

An automatic control is provided for the step-bearing pumps serving one of the vertical turbines in the Blue Island plant of the Public Service Company of Northern Illinois, so that if the accumulator weights fall below a fixed level steam is admitted to the bearing oil pumps, re-



AUTOMATIC CONTROL OF STEP-BEARING OIL PUMP

storing the high-pressure supply. A cord fastened to the accumulator weights passes over a pulley and is attached to a lever of a spring valve in the steam line of the pump. If the weight gets low, it pulls upon the valve, turning steam into the pump until the high-pressure oil supply again reaches its normal quantity.

Energy Losses in a Large Electric-Service System

In an appendix to the recent report of Mr. Ray Palmer, city electrician of Chicago, on the maximum-rate investigation of the Commonwealth Edison Company appears the diagram reproduced herewith. It shows roughly the principal elements of a large electric-service system, with the energy losses in various parts. The figures given indicate approximately the percentage of the potential energy in the coal utilized by various parts of the system. The figures applying to customers' premises show the percentage of the energy in the coal burned which is actually utilized in the

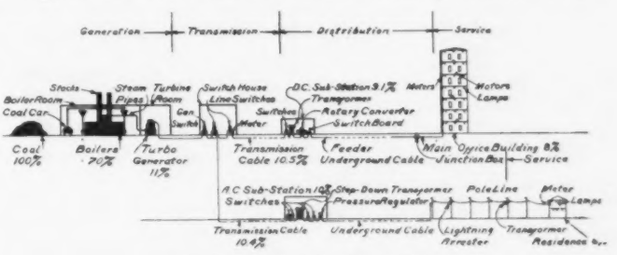


DIAGRAM OF ENERGY LOSSES

translating appliances of the consumer. The lower diagram shows the alternating-current distribution system, the direct-current system being indicated on the upper level.

In Chicago electricity is generated in turbo-alternators at 9000 volts to 12,000 volts and transmitted through underground cables to substations, where it is reduced in voltage for distribution. In the central part of the city—that is,

the territory south of North Avenue, east of Ashland Avenue and north of Thirty-ninth Street—direct-current transmission is used. Outside of this central district alternating-current is employed.

Burners for Oil Fuel—I

By R. T. Strohm

The purpose of the burner is to spray the oil fuel into the furnace; consequently the first requisite of a good burner is that it shall atomize the fuel satisfactorily. As oils are of different densities and viscosities, and as different rates of feed must be used to accommodate the rate of combustion to the load on the boiler, it follows that the burner must be fitted with suitable valves in order that its action may be regulated closely. This regulation applies not only to the oil but to the atomizing medium as well.

A second important feature of a good burner is accessibility for cleaning and repair. It is almost impossible, even after taking the precaution of cleaning and straining, to prevent dirt from being carried along with the oil. As a result, clogging of the oil orifices may occur, and it then becomes necessary to clean the burner. To do this easily and quickly, the burner must be designed so that it may be taken apart readily and without undue labor. In some types of burners the oil and steam currents cause erosion,

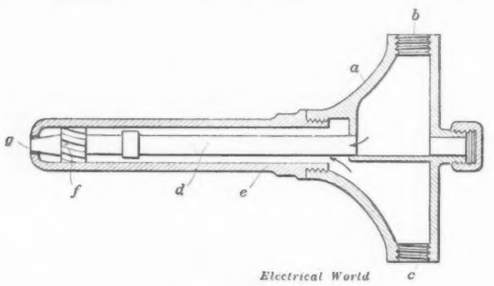


FIG. 1—REGULAR GEM OIL BURNER

and in such forms it is necessary to make provision for removing and renewing the worn parts without loss of time.

A form of Gem burner designed particularly for use in small furnaces is shown in Fig. 1. Its body *a* is of cast iron and contains two inlets *b* and *c*, the former for the oil and the latter for the steam that is used as the spraying agent. The oil flows along the central pipe *d* and escapes at the tip of the burner. The steam passes along the pipe *e* surrounding the oil pipe and is given a whirling motion by the vanes of the whorl *f* near the tip. It then escapes past the conical end of the oil pipe, through an annular opening *g*, sweeping the oil into the furnace.

As the oil pipe *a* is surrounded by live steam throughout its entire length, the oil becomes well heated in flowing through the burner, and the effect of this heating is to make it more fluid and easy to atomize. The regulation of the flow of oil and steam is accomplished by valves in the pipes attached at *b* and *c* respectively, since there are no moving parts in the burner itself. Should the oil pipe become clogged with dirt, the cap at the back may be unscrewed and a rod may be inserted to remove the obstruction.

An improved form of this burner is shown in Fig. 2. It differs from the form shown in Fig. 1 mainly in that it has a needle valve included in the burner to enable the oil flow to be regulated more closely. The stem *a*, Fig. 2, of the needle valve is threaded near its inner end and passes through a stuffing-box *b* at its outer end; thus any expansion of the stem due to increase of temperature does not alter the adjustment of the valve, as it would do if the stem were threaded at the stuffing-box end. The oil surrounds the stem inside the pipe *c* and flows to the nozzle through grooves cut in the side of the stem. The atomization is effected in the same way as in the simpler type. Each of these burners may easily be unscrewed and taken apart for cleaning.

The Parson burner illustrated in Fig. 3 is similar in principle to that shown in Fig. 2. The tip of *a* of the Parson burner has a passage *b* for the steam, which is admitted through the connection *c*. The oil enters at *d* and flows

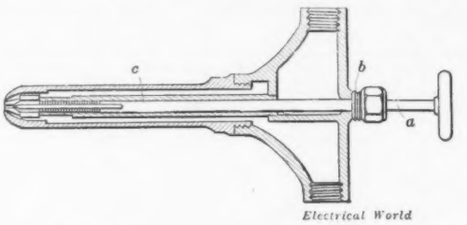


FIG. 2—IMPROVED GEM OIL BURNER

into the chamber *e*, from which it is allowed to pass into the nozzle *f* past the regulating valve *g*. This valve has a very slight taper, and consequently the flow of oil can be adjusted with great precision. The nozzle projects through the center of the steam passage in the tip, and the oil is thus heated on its way to the furnace. The valve stem *h* is furnished with a stuffing-box *i* to prevent the leakage of oil.

The Booth burner, shown in Fig. 4, is one that has been used extensively in stationary-boiler practice. The body of the burner consists of a box-shaped casting *a* that is set horizontally. It contains two passages *b* and *c*, oil being admitted to the former through the pipe *d* and steam to the latter through the pipe *e*. The oil flows outward through the wide, shallow slot *f* at the tip of the burner and drools downward across the end. An adjustable steel plate *g* is bolted across the steam orifice. This plate has a long notch cut in the top edge, forming the outlet *h* for the steam, and on the inside it is beveled or chamfered so as to direct the steam upward toward the orifice. The escaping steam sweeps along the under side of the burner tip and in expanding sprays the oil that runs down from the upper slot. The bolts that hold the plate *g* in place pass through long vertical slots in the plate, and this construction allows the plate to be moved up or down to give the desired depth of slot *h*. This adjustment, of course, is made when the burner is disconnected and not in use.

The arrangement of the piping to the Booth burner is simple. The supply of steam is brought to the burner through the pipe *e*, the flow being regulated by the valve *i*. In the same way a valve *j* in the oil line *d* is used to control the rate of flow of the oil. Between the oil pipe and the steam pipe is inserted a short connection fitted with a valve *k*. This serves as a by-pass to admit steam to the oil passage when it becomes necessary to clean out the passage. The oil valve *j* and the steam valve *i* are first closed and then the by-pass valve *k* is opened. The steam rushes through the oil passage, and its heat and its cutting

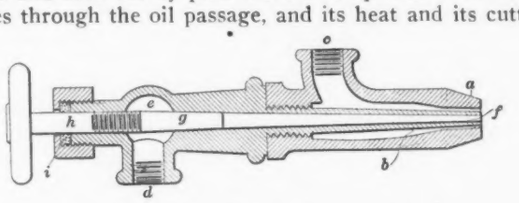


FIG. 3—PARSON OIL INSPIRATOR

action together scour the passage clean. The steam passage may be cleaned by removing the plate *g* completely and allowing steam to blow through at full pressure. The passages in the burner are straight and fairly large, and there is little danger of their becoming clogged frequently.

A form of externally atomizing burner known as the Best burner is shown in Fig. 5. The tip by which the atomizing

is accomplished is supported by two pipes *a* and *b* that convey the steam and the oil, and these pipes are made of such length that they will extend through the boiler front and bring the burner just within the front of the furnace. The tip is of cast iron and contains a steam passage *c* and an oil passage *d* connecting with the oil pipe *b*. The oil passage is curved upward, so that the escaping steam sweeps

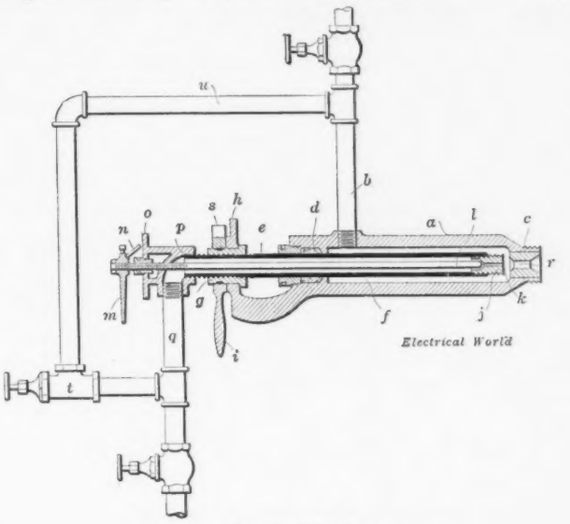


FIG. 4—BOOTH OIL BURNER

across the face of the orifice *e* at right angles to the direction of flow of the oil, thus insuring excellent atomization. Moreover, it is stated that this arrangement of the two orifices causes the steam to have a sort of ejector action on the oil, with the result that the oil is drawn toward the orifice *e* and only a low pressure is necessary in the oil system.

The steam orifice *f* is a long, shallow slot in the under face of a hinged lip *g* that during the normal working of the burner is held down firmly against the body of the tip. A fork *h* is pinned to the lip and has fastened to it a rod *i* that is threaded at its outer end and fitted with two adjusting nuts *j* and *k* on opposite sides of the bracket *l*. When the steam passage becomes clogged or choked, these nuts are turned so as to force the rod *i* inward and swing the lip upward. Full steam pressure is then turned on to blow out the obstruction, after which the lip is drawn down on its seat. This may be done from the front of the boiler without disturbing the setting of the burner. The flow of oil is regulated by a cock *m* and the steam supply by a

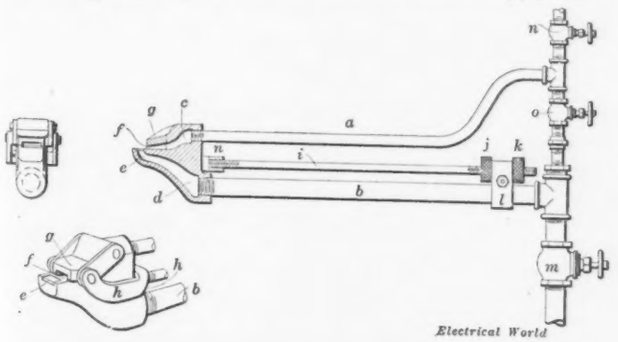


FIG. 5—EXTERNALLY AUTOMIZING BEST BURNER

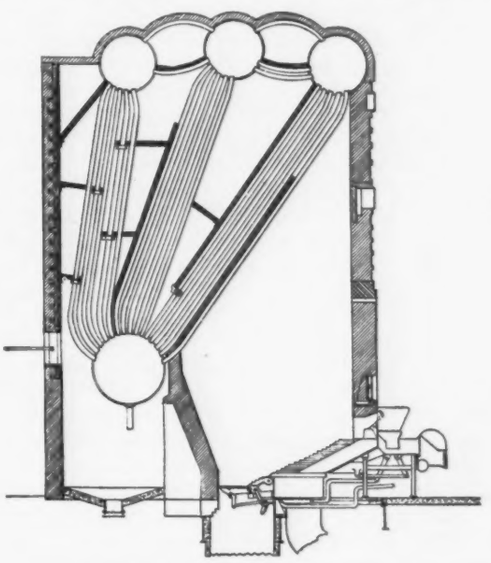
valve *n* in the steam pipe. A by-pass valve *o* is inserted between the steam and oil pipes, to enable the oil side of the burner to be cleaned out readily, as explained before.

The construction of the Best burner is such that there is little or no wear, and the absence of needle adjusting valves and constricted passages reduces the likelihood of clogging. If desired, this burner may be operated with tar as fuel, and it is equally serviceable with heavy oils. The flame produced is fan-shaped and spreads to about the width of the boiler furnace.

Improved Baffling Arrangement with Large Combustion Chamber

At its recently completed Park Place heating plant the Central Heating Company, of Detroit, Mich., has adopted a modification of the baffling arrangement without the arch, as employed with such success and increased efficiency in the 500-hp boilers of the Detroit Edison Company's Delray station. At the latter plant boiler efficiencies as high as 80 per cent have been obtained in the region of rated loadings, while the units are capable of heavy overloads.

In the case of the new Park Place boilers, however, the mud drums have been raised 10 ft. above the boiler-room floor in order to secure increased combustion-chamber space. The number of passes is limited to three, the damper being placed at the mud drum. This reduction from the four passes obtained with the highly efficient Del-



MODIFIED BAFFLING ARRANGEMENT

ray boilers was made for the purpose of reducing the drop in draft through the setting. The Park Place boilers have a nominal rating of 727 hp, but will be operated over a range from 75 to 250 per cent of normal horse-power capcity.

Load on Double-Turbine Unit

When a high-pressure steam turbine exhausts into a low-pressure turbine and the two turbines drive alternators independently connected to a common supply system, what governs the division of load between the alternators? C. O.

Between any two alternators connected in parallel the division of load is determined by the load characteristic and operating conditions of the prime movers. In the case outlined each alternator would deliver to the system such power as it received from its turbine, less the losses in the alternator itself. With two "series-connected" turbines the relative amount of power developed by each depends upon the admission and exhaust pressures and the mechanical efficiencies in each case. When driving alternators the relative speeds are set by the number of generator poles, and no governor need be provided for the low-pressure turbine since it utilizes such steam as is exhausted from the high-pressure turbine, to which steam is admitted in accordance with the total load to be carried by the double-turbine unit.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Single-Phase Motor.—A. Heyland.—An illustrated description of a new single-phase motor, which the author claims can be built with the same dimensions at the commutator and the same commutator voltage as a direct-current motor. The result is that the dimensions of the motor, its losses, heat and efficiency may be held within the same limits as in direct-current motors. The principle is the superposition of two motors in the same armature. One is a series motor which is fully loaded and the other is a repulsion motor which is slightly loaded, that is, loaded only temporarily and during the starting operation. The short-circuit axis of the repulsion motor is neutral to the main axis of the motor. Potential differences between commutator segments below the brushes occur only in the repulsion motor, and as the latter may be designed for a low number of ampere-turns the short-circuit currents below the brushes may be maintained as low as desired. At the same time, "the repulsion axis is automatically always loaded in such a way that all disturbances are kept away from the main brushes, so that the main brushes are continually, even during starting, in an absolutely neutral zone, just as is the case with direct-current motors." The motor is of the two-brush-axis type (Fig. 1a), the short-circuited axis being perpendicular to the main axis. The short-circuit axis impresses an elliptic field upon the armature in such a way that below the brushes the emf of rest is always compensated by the emf of motion. At speeds above synchronism the larger axis of the elliptic field is in the direction of the short-circuit axis; at speeds below synchronism it is in the direction of the main brushes. In the new type of motor of the author this is avoided in such a way that by a displacement of the field (Fig. 2) the load currents are first temporarily impressed on the short-circuit brushes; when the speed increases and the main field is strengthened, the load currents are taken over by the main brushes. The main brushes, therefore, behave continually as in a direct-current motor and may, therefore, be dimensioned as normal broad brushes. The reactance voltage may be overcome by the same means as in direct-current motors. The author gives six different diagrams showing possible connections of the motor when loaded. In Fig. 1, a, b, c, three of these diagrams are reproduced. Fig. 1a shows a simple "Atkinson motor" with a double-axis short-circuit. The connections shown in Fig. 1b are obtained by opening the circuit of the main brushes and connecting them to the mains as shown in diagram b. This motor has a shunt characteristic; that is, its speed can be adjusted to a fixed value by means of the transformer *f* and is independent of the load. The stator and the rotor windings may be connected in parallel or in series. The former arrangement is shown in Fig. 1b, the latter in Fig. 1c. With parallel connection the field and the overload range of the motor increase with increasing speed. With series connection they decrease. For traction purposes the connections of Fig. 1b are considered the most suitable ones. The starting operation is accomplished in such a way that by a displacement of the field the short-circuit axis is temporarily made the load axis, the motor starting as a repulsion machine. A change of the connections is preferably made near synchronism, since then the voltage between the main brushes is zero. The displacement of the field during the starting operation may be obtained either by displacement of the brushes or by a change of the connections at the stator. The author gives six different starting arrangements, of which only one, Fig. 2, is reproduced herewith. It is the simplest method, the motors starting with open circuit of the main brushes. When the motor has reached synchronism the circuit of the main brushes *BB* is closed to obtain position of Fig. 1a, whereupon further speed regulation may be obtained by a gradual increase of the voltage at the brushes *BB* according to Fig. 1b. That is, the auxiliary brushes *bb* are continually closed and all changes of connection are made in a circuit without voltage. The change of connections may be made entirely automatic by keeping the switch *a* in Fig. 2 first open by means of a voltage-operated coil connected to the brushes *BB*. At synchronism, where the voltage between *BB* becomes zero, the switch will then automatically close. The author concludes that the change from the connections of Fig. 2 to those of Fig. 1a and 1b is the simplest and most economical method of operation. Motors of this type may be built for single-phase railroads in which parts of the line are operated by direct current, so that the motor can be operated as a direct-current machine without the necessity of connecting several motors in series as is necessary with other single-phase motors. For traction purposes the dimensions of the machine are those of a low-voltage direct-current motor. It has series characteristics during starting and shunt characteristics during normal operation. It is possible to recuperate energy usefully. In the simplest form of the motor the field increases as a linear function of the speed and adjusts itself to the conditions of traction in such a way as always to operate most economically at all loads. The same principle may also be used in the design of polyphase motors.—*Elek. Zeit.*, July 24, 1913.

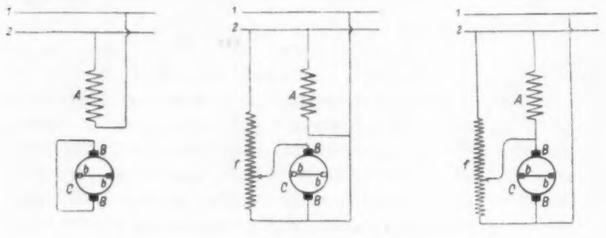


FIG. 1—DIAGRAM OF CONNECTIONS

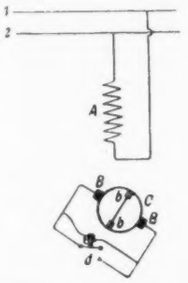


FIG. 2—DIAGRAM OF STARTING ARRANGEMENT

Lamps and Lighting

The Lighting of Schools.—An account of the recent report of a joint British committee which is chiefly representative of the (British) Illuminating Engineering Society, but also includes representatives of the Association of Technical Institutions, the Association of Teachers in Technical Institutions, the London Teachers' Association and the Medical Officers of Schools Association. It is recommended that for clerical work the minimum artificial illumination on any desk where light is required should not fall below 2 ft.-candles, though apparently four members of the committee are of the opinion that the minimum should not be less than 2.5 ft.-candles. For special work, such as stitching with dark materials, a minimum of 4 ft.-candles is suggested, while for general illumination it is recommended that a minimum of 1 ft.-candle should be adopted. All measurements are made upon a horizontal plane 3 ft. 3 in. above the ground, which appears to be a satisfactory height for measurements in this class of work. The recommendation is made that no lamps should come within the solid angle subtended at the eye by the blackboard and a space 2 ft. above it, unless they are completely screened from the eye by shades impervious to light. The subject of daylight illumination is to be taken up in a further report.—London *Electrician*, July 25, 1913.

Lighting of Libraries.—An account of a recent report of a joint committee of the (British) Illuminating Engineering Society and associate delegates. For table, desk or newspaper stand lighting the illumination should in no case be less than 2 ft.-candles. This value is understood to apply to reading ordinary type printed on white paper. When books printed in small type or manuscripts or surfaces having a low reflecting power are to be studied a higher illumination is necessary and a tentative value of not less than 5-ft. candles is suggested. For bookcase and shelf lighting the minimum vertical illumination on the case or shelf should be 0.5 ft.-candle. For general illumination a minimum of 0.5 ft.-candle is specified. Local illumination should be measured on the desk, slope or table where reading is carried on. Measurements of general illumination should be made on a horizontal surface 3 ft. 3 in. above the ground. In all cases the illumination is to be expressed in foot-candles. Special emphasis is laid on the avoidance of glare, the avoidance of reflection from the surface of paper or tables and the avoidance of shadows.—London *Electrician*, July 25, 1913.

Traction

Paris.—A note on the Paris Metropolitan Railway, stating that the number of passengers carried by this undertaking has increased from 100,000,000 during 1903 to nearly 311,000,000 during 1913. This is partly due to the new sections which have been constructed, bringing the total length of the line up to 46 miles. The ratio of working expenses to receipts for last year was 42.52 to 100.—London *Electrician*, July 25, 1913.

The Mechanics of Electric Train Movement.—An account of the extended discussion which followed the presentation of Mr. F. W. Carter's paper on the above subject.—London *Electrician*, July 18 and 25, 1913.

Generation, Transmission and Distribution

Pressure Regulation.—E. WYATT.—An abstract of a paper read before the Newcastle Students' Section of the (British) Institution of Electrical Engineers. The author discusses the requirements of the continuity of supply, design and maintenance of cables, methods of regulation and independent regulation of feeders. Among the automatic regulators which he mentions is the Taylor-Scotson automatic regulator, which consists of a small booster, in series with the exciter field coils when used in conjunction with alternators or with the shunt field coils when applied to direct-current machinery. The field current of this auxiliary booster is obtained from any available continuous-current supply, the field coils being split into two halves connected differentially. An assisting or opposing boost is given to the exciting field magnetism, according to which half of the coils is in operation. The whole of the assisting or opposing boost is given at one step by short-circuiting one or other of the differential windings. This is effected by a solenoid or pressure-operated coil.—London *Electrician*, July 25, 1913.

Gas Engine Plant in Japan.—A description of the new gas engine plant of the Kawaski Dockyard Company, which has scrapped its old steam plant. A 500-kw generator has been installed directly coupled to a four-cylinder scavenger-type producer-gas engine, together with the necessary gas plant.—London *Elec. Review*, July 25, 1913.

Installations, Systems and Appliances

British Central Station.—An abstract of last year's financial report of the St. Marylebone (London) municipal electric station. As the price of coal advanced by 30 per cent, and the low candle-power, high-voltage metallic-filament lamp made further inroads into energy consumption for lighting, the results were not as satisfactory as expected. However, motor connections have increased and energy consumption for heating and cooking has increased at even a greater rate. The output during the year was 15,000,000 kw-hr., the total number of consumers 9234 and the total connections 25,556 kw. The generating expenses per kw-hr. sold were 1.04 cents, the distribution expenses 0.24 cent, the management expenses 0.28 cent, rents, taxes, etc., 0.56 cent; hence the total cost per kilowatt-hour sold, exclusive of capital charges, was 2.12 cents, and including capital charges 5.76 cents. The total revenue was 6.16 cents.—London *Electrician*, July 25, 1913.

Electrophysics and Magnetism

Ferrocobalt Magnets.—PIERRE WEISS.—The compound Fe_2Co of iron and cobalt has a magnetic saturation value 10 per cent higher than iron at ordinary temperature. The results of measurements are given showing the possibilities of producing stronger magnetic fields with an electromagnet with ferrocobalt pole pieces than is possible with iron.—*Comptes Rendus*, Vol. 156, p. 1970, 1913; abstracted in *La Lumière Elec.*, July 19, 1913.

Spark-Gap.—J. P. MINTON.—This article presents the results of an experimental investigation of the effect of dielectric spark-lag upon both needle and sphere gaps, which go to show that the sphere-gap is the more reliable, on account of the lesser dielectric spark-lag which it is found to possess. The correctness of this conclusion is still further confirmed by a theoretical argument based on Maxwell's theory of stresses. This type of gap should, therefore, be used wherever possible, especially for the measurement of voltages of short duration.—*Gen. Elec. Rev.*, July, 1913.

Nature of Dielectric Fatigue.—W. HOLTTUM.—An account of an investigation the object of which was to determine the relation between the duration of application of the pressure and the instantaneous strength when identical samples were tested at constant pressure and frequency. Alternating pressures were used. Instantaneous strength is defined as the pressure of a certain wave shape which would just cause breakdown if applied for one-tenth of a second at a frequency of 50 cycles per second. The arrangement of the experiments is described in detail and the results obtained with ebonite and presspahn are discussed. The general conclusions to be drawn from these tests are that fatigue due to electric stress alone is almost negligible for ebonite and presspahn until the point of breakdown is approached, the greatest amount measured for ebonite being 2 per cent of the initial instantaneous strength (as defined above), and that the least pressure which will cause breakdown if applied continuously is about 80 per cent of the lowest measured value to which the in-

stantaneous strength can be reduced by fatigue. The conclusion of greatest practical importance that can be drawn from these tests is that the dielectric strength of ebonite for sudden stresses lasting for a fraction of a second is only some 28 per cent greater than it is for long-continued stress, and that any ebonite used for insulation purposes should be designed for the greatest pressure which may occur as though that pressure were continuous.—London *Electrician*, July 25, 1913.

Units, Measurements and Instruments

Meter.—An official announcement of the German Reichsanstalt by which a new oscillating motor meter for direct current of the Allgemeine Elektricitäts Gesellschaft is admitted for calibration. Its construction is described in detail and illustrated by diagrams.—*Elek. Zeit.*, July 24, 1913.

Electric Measuring Machine.—P. E. Shaw.—An abstract of a paper read before the British Institution of Mechanical Engineers on a new electric machine for the accurate measurement of end-gages of length. The machine (Fig. 3) consists of a heavy cast-iron bed, on which travel two headstocks and a gage-holder. The latter provides for the accurate adjustment of the gage in position with regard to the bed, and for its movement between the measuring ends, so that every part of the ends of the gage can be measured without risk of introducing error by the displacement. Each headstock is provided with a "measuring end," a micrometer screw and a reading microscope. The accompanying illustration shows one of the measuring ends. In the older machine direct electrical contact

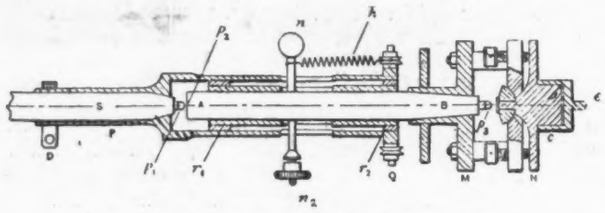


FIG. 3—SECTION OF A MEASURING END

was made between the point p_1 and the gage; in the present machine, if point contact is to be made, one either uses the extreme point e or the point p_2; in the latter case the end piece $M\ N$ is pulled off the bar $A\ B$. For most purposes p_2 is better than e for point contact. If, on the other hand, we wish to measure with flat ends, the end cap c is pulled off, leaving the lapped flat surface b at the extreme end. The brass tube $P\ Q$ is coned to fit the screw spindle S, so that when pushed on the latter and the clamp D adjusted the whole forms a rigid system. The invar bar $A\ B$ is made a true fit in the ebonite bush rings r_1 and r_2, and is prevented from rotating on its axis by the cross pin $n\ n_2$, which slides in the slotted brass tube. The end of $A\ B$ *is* coned, and the coned end of the fitting $M\ N$ is pushed tight on $a\ b$, the two parts being ground to fit. By means of adjusting screws the end surface b can be brought into a plane perpendicular to the line of the bed. A spring h controls the system and keeps the contact points p_1 and p_2 about ½ mm apart normally; S is the invar shaft of a micrometer screw. Suppose this screw is advanced to cause the end of the system to meet a gage surface on the extreme right beyond e. First e meets the gage, then, as the screw is farther advanced, contacts p_1 and p_2 are brought together. The meeting of p_1 and p_2 completes an electric circuit consisting of a high resistance (say, 5000 ohms), a cell, switches and telephone. As soon as the telephone sounds, the observer reads the divided head of the micrometer screw. On reversing the micrometer screw the spring h comes into action, breaking contact $p_1\ p_2$ and the telephone again sounds.—London *Elec. Review*, July 25, 1913.

Roentgen-Ray Tubes.—Fr. Klingfuss.—An illustrated abstract of a paper on tests of X-ray tubes by means of instruments at present available.—*Elek. Zeit.*, July 24, 1913.

Telegraphy, Telephony and Signals

Wireless Telegraphy.—G. W. O. Howe.—A system is in use by the Société Française Radio-Électrique involving an intermediate transforming circuit, in which it is claimed that a single wave is emitted with the closest couplings. The author shows mathematically that this is impossible and describes experiments which fully confirm his calculations. He concludes that the claims of the French company are apparently based on a fallacy, and the method described in the patent specification and used by the company does not enable the coupling to be made any tighter than the ordinary system, without introducing the same defects.—London *Electrician*, July 25, 1913.

Miscellaneous

German Association of Electrical Engineers.—Zehme.—The twenty-first annual meeting of the German Association of Electrical Engineers was held from June 17 to 21 in Breslau. The president, Christiani, reported on the development of electrical engineering during the past year. Usbeck lectured on the commercial importance of electric traction on trunk railroads. The secretary, Dettmar, reported that the number of members is 5300. There are twenty-two local sections and the society owns $52,000. Seventeen committees have been working during the past year. For the first time scholarships—forty-four in number—have been granted to students of electrical engineering from the Max Günther Stiftung. S. Ruppel presented a paper on protection of buildings against lightning, Weidig and Jensch one on corona losses on transmission lines, B. Monasch one on new electric sources of light. In the discussion of the latter paper the Allgemeine Elektricitäts Gesellschaft stated that it had succeeded in making high-candle-power incandescent lamps with a specific consumption of 0.5 watt per hefner-candle. G. Klingenberg presented a paper on the distribution of electric energy over extended districts. The banquet was attended by 600 members and ladies. Various excursions were made, among them one to the Riesengebirge, where the electrification of the mountain railroads was inspected.—*Elek. Zeit.*, July 10, 1913.

Students' Tour.—An account of the recent tour made by the Student Section of the (British) Institution of Electrical Engineers. This covered the Newcastle district. An account is given of the various visits made.—London *Electrician*, July 25, 1913.

Book Review

Electric Wiring and Lighting. Part I. Electric Wiring By Charles E. Knox. Part II. Electric Lighting. By George E. Shaad. Chicago: American School of Correspondence. 94 pages, 81 illus. Price, $1.

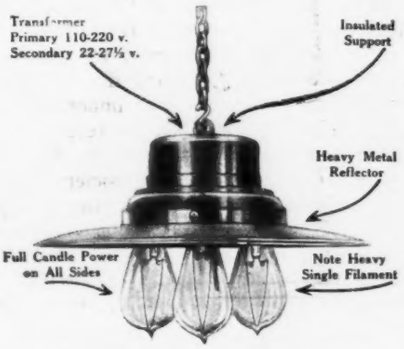
This book accomplishes to an unusual degree its purpose in presenting in an instructive way for home study the progress in electric wiring and illumination. The treatment is concise, the mathematics simple, and in 100 pages most of the ordinary methods of wiring with simple calculations and most lighting methods are covered with surprising thoroughness. Illustrations and diagrams are numerous and clearly explanatory of the points brought out in the subject matter. The features of safety and convenience are particularly emphasized, and the data and suggestions are such as to make the book not only well adapted for the non-technical beginner but of considerable use as a reference for the interior wiring contractor and the inspector.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Transformer-Reflector Fixture

On account of the smaller diameter of the filament, low-candle-power lamps are more fragile than high-candle-power units for the same voltage, and high-voltage lamps are more fragile than low-voltage units for the same candle-power. The most fragile units are therefore the low-candle-power, high-voltage lamps. To overcome this disadvantage, the Campbell Electric Company, Lynn, Mass., has

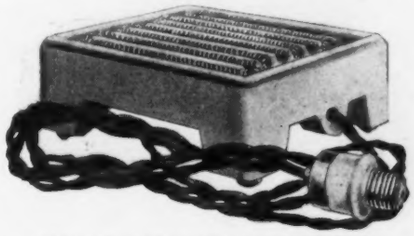


TRANSFORMER-REFLECTOR FIXTURE

placed on the market a transformer fixture by means of which low-voltage lamps may be used in the fixture even when the distributing circuits are operated at high voltage. The miniature transformer mounted immediately above the reflector receives energy at the regular distribution voltage and delivers it at a convenient low voltage for the lamps. It is said that this fixture is used in large quantities by some of the extensive mills.

Non-Metal Electric Toaster

The electric toaster illustrated herewith is said to be very efficient in that all the heat is radiated in a useful direction. The utilization of practically all of the heat generated is accounted for by the material of which the toaster is constructed. In place of having a metal body which will conduct away considerable heat, the toaster is



NON-METALLIC ELECTRIC TOASTER

constructed entirely of an asbestos compound with the heating coils laid in grooves in the top of the device. Asbestos being a poor conductor of heat allows the heat generated to radiate upward in a useful direction. In addition to the added efficiency of operation, there is no metal from which one can get burned. Although designed as a toaster, the appliance can be used as a general-utility stove with ordinary cooking utensils. The device consumes 400 watts, is neat in appearance, will not tarnish or rust and, it is asserted, will withstand considerable abuse. The toaster is manufactured by the National Electric Company, Chicago.

Tubular Electric Signs for Display Purposes

An electric sign for interior display purposes, the lamps in which serve to illuminate the sign as well as the show case or display window beneath it, was on exhibition for the first time at the window trimmers' convention held re-

FIG. 1—TUBULAR ELECTRIC SIGN

cently in Chicago. The sign consists of a rectangular frame made of copper-plated brass, in which opal glass tubes 2 in. in diameter and 4 in. long, each bearing a letter, are placed vertically so as to spell the display word. As the tubes are made of translucent glass, the space occupied by the letters is left bare and the remainder of the tube is copper-plated for contrast. Inside of the tubes and fastened to the upper horizontal member of the frame are miniature receptacles for holding 8-cp candelabra lamps. These receptacles are connected in parallel to a flexible cord and plug which may be inserted in an electric lamp outlet.

The frames are made in lengths to accommodate different numbers of tubes, which can be replaced by others by taking off the top horizontal member of the frame. In the lower horizontal member, below each tube, is a hole having the same diameter as the inside of the glass tubes. The light from the small candelabra lamps can shine through

FIG. 2—TUBULAR ELECTRIC SIGN

this opening and illuminate anything placed below the frame without reducing the effectiveness of the sign. As the lamps are entirely concealed, the sign is as attractive in the daytime as it is at night.

Another type of tubular sign displayed by the same company consists of a hollow, cylindrical translucent glass tube with a perforated metal cap on each end. Fastened to each

of these caps inside of the tube are receptacles for holding 10-watt tungsten lamps. The lamps are connected in parallel to a flexible cord which can be attached to an electric lamp outlet. The tube is copper-plated except for the space occupied by the display feature. As only about one-third of a cylindrical surface can be seen at close range, the tubes can be installed in three sections, each of which bears different advertising material. The tubes are replaceable so that the sign fills a utilitarian place in any store display window or case. Either one of the signs mentioned can be suspended from above by chains, the heat radiated from the lamps being carried away through perforated caps. These signs are made by the Sterling Deposit Manufacturing Company, Chicago.

Motor-Driven Air Washer

In order that the air supply furnished to the banking rooms, engine rooms, pump rooms, café, barber shop, lavatories and other departments in the lower portion of the Woolworth Building, New York City, may be uncontaminated air washers have been installed to cleanse and purify it. From an opening over the street the air is drawn in through sprays of water in an atomized condition. The atomizer equipment and its supporting framework are shown in Fig. 1 The air passes through this spray and is led through a series of baffles, where the greater portion

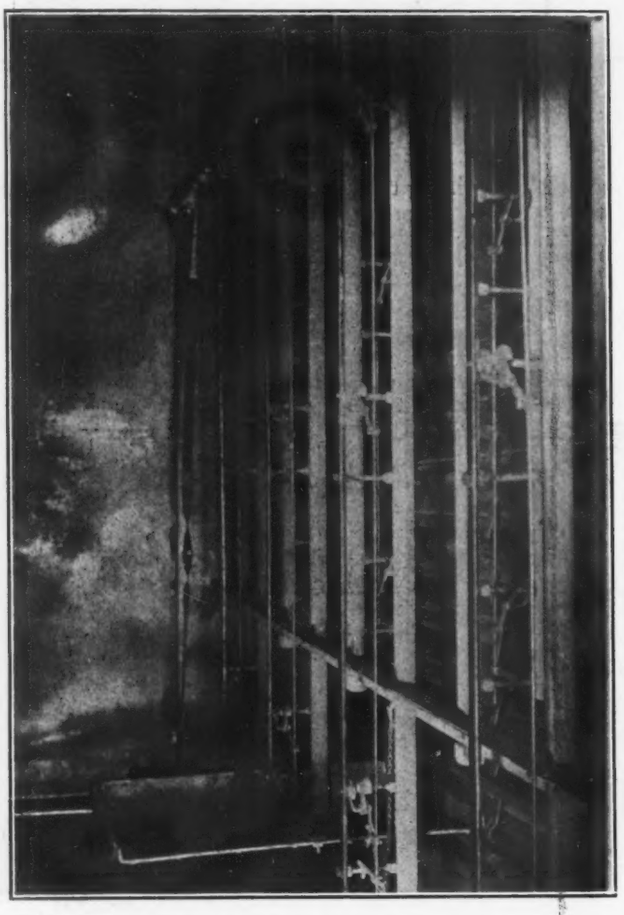


FIG. 1—AIR-WASHING EQUIPMENT

of the entrained moisture is removed. After passing the baffles the air is delivered to the rooms themselves, being then free from foreign matter and cooled to within 3 deg. Fahr. of the temperature of the purifying water.

The equipment for pumping the water to the atomizing nozzles consists of a small motor-driven centrifugal pump which is mounted on the basement floor near the door opening into the spray compartment. In order that the nozzles may not become clogged by continuous use of the water, which will in time accumulate some dirt, an arrangement is provided for periodically changing the direction of the spray. The pan seen in Fig. 1 catches the falling spray, and when the weight of the water contained in it becomes sufficient it is automatically emptied. This motion

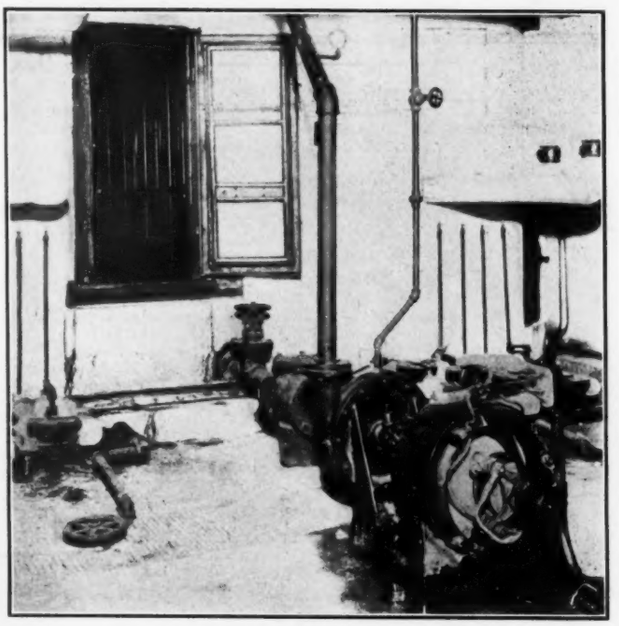


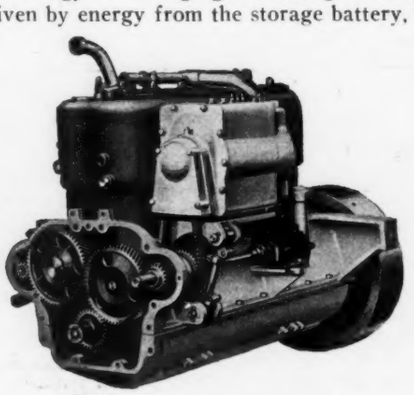
FIG. 2—MOTOR-DRIVEN PUMPS

of the pan is transmitted through a set of levers to appliances on the atomizing nozzles which change the direction of the spray and blow any foreign matter out of the nozzles.

The air-washing equipment in this installation was furnished by the Kauffman Heating & Engineering Company, St. Louis, Mo.

Automobile Starting and Lighting System

In the system of electric starting and lighting of automobiles illustrated herewith both of the functions indicated are performed by one unit which operates as a generator to produce energy for charging the storage battery or as a motor, driven by energy from the storage battery, for start-



DYNAMO FOR AUTOMOBILE STARTING AND LIGHTING SERVICE

ing the automobile. The unit changes from motor to generator, or the reverse, without automatic switches, controllers or auxiliary devices, and without any change in gear reduction. The generator-motor unit is geared permanently to the gasoline engine by means of a silent chain.

The equipment is built in two sizes for application to four-cylinder or six-cylinder cars. The battery with the

former is rated at 35 amp-hr. and that with the latter at 50 amp-hr., the electromotive force in each case being 18 volts. The generator-motor is an 18-volt four-pole machine provided with two series-wound poles, use being made of an auxiliary shunt-wound "bucking coil" for regulating the output.

With the automobile stationary, closing the control lever

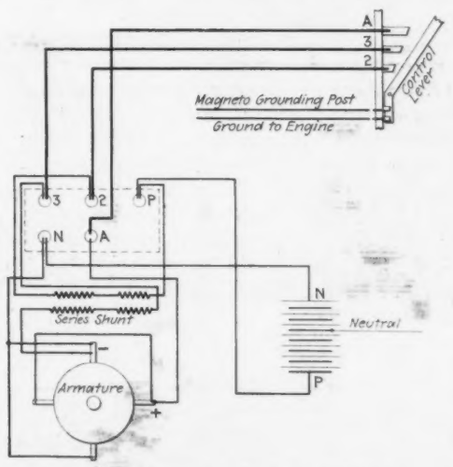


FIG. 2—DIGRAM OF CONNECTIONS

switch causes energy from the battery to pass through both the series and shunt windings in the same direction, the "bucking coil" augmenting the series coils. When the engine speed becomes sufficiently high for the generator voltage to exceed that of the battery, namely, at about 800 r.p.m., the function changes from motor to generator. The voltage rises with the increase in speed until a maximum charging current of 15 amp is reached at about 3600 r.p.m.; a further increase in speed reduces the current delivered to the battery. The regulation of the current is accomplished automatically through the agency of the bucking coils. Current in these coils neutralizes the effect of the series coils. The regulation is thus a feature of the design rather than of automatic switching devices. The rate of charging is so proportioned to the service required of the battery that the tendency is for the battery to be overcharged rather than undercharged. In order to prevent heating and gasing of the battery by reason of too much overcharge provision is made for disconnecting the generator in case of long-continued running at high speed.

The above-described equipment, known as the A-B Entz system, is built by the Adams-Bagnall Electric Company, Cleveland, Ohio.

Transformers for Manholes

Manholes and underground chambers are usually damp and quite frequently are flooded, so that it often becomes necessary for the transformers to continue in service while partly or wholly submerged in water. A transformer for such service must therefore be water-tight and air-tight. The joints between the case and cover, as well as those where the leads issue from the case, must be of such a construction as to prevent any possibility of moisture entering the case.

On account of the poor ventilation in manholes and the resultant fairly high temperature, transformers for this service must have low temperature rise. Owing to the limited space available for installation and handling, they must be compact but at the same time rugged in design.

In the transformer herewith illustrated the joint between the cover and case is made waterproof and air-tight by means of a wire gasket fitting in a V-shaped groove in the case. This wire is an alloy of tin and lead which is said to give excellent results for this purpose. The cover is secured to the case by a number of bolts placed around the periphery of the case; as these are tightened, the wire gasket is compressed and its shape is slightly changed so as to conform exactly to that of the groove. Sherardized bolts and nuts are used so as to prevent rusting of the nut and bolt together and resulting difficulty of removing the cover from the tank.

Since these transformers are made air-tight, internal pressures are developed due to the expansion of the air and oil, caused by an increase in the temperature. An air space between the oil level and the cover, however, forms an effective cushion for taking care of the expansion of air and oil.

The bushings furnished with these transformers not only prevent moisture entering the case but are so designed that

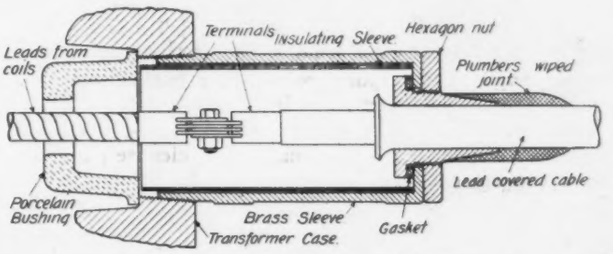


FIG. 1—TRANSFORMER BUSHING

it is possible to connect and disconnect the transformer very readily. As the space in the manhole is usually quite limited, this feature is of advantage. The method of bringing out the leads from the transformer through the outlet bushings is shown in detail in Fig. 2. The leads are brought from the coils through a heavy porcelain bushing and terminate in leaf connectors. Connection is made to the line by inserting the leaves of a similar connector to the lead-covered cable and tightening a bolt which is inserted in a hole passing through all the leaves. A brass sleeve with an insulating lining is slipped over the connection and

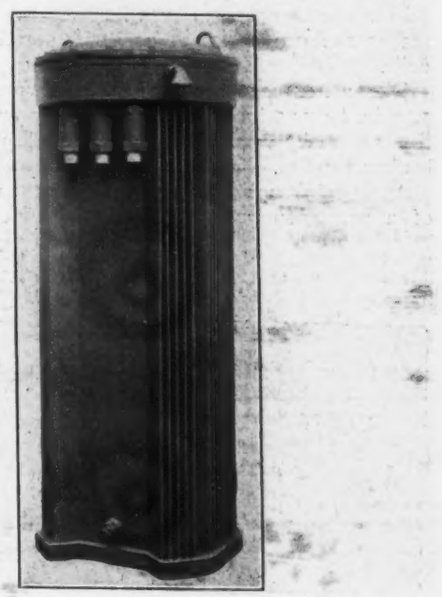


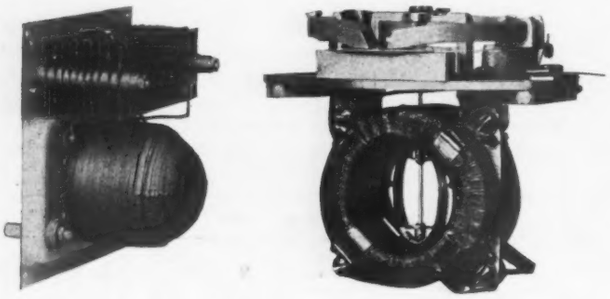
FIG. 2—MANHOLE TRANSFORMER

screwed into the transformer case. The lead casing of the cable is connected to a flanged sleeve by a plumber's wiped joint. A nut is used to force this sleeve to a seat on the gasket in the outlet bushing, by this means making a water-tight joint.

This line of transformers has been placed on the market by the Westinghouse Electric & Manufacturing Company.

Portable Meters for Alternating-Current or Direct-Current Circuits

The fundamental advantages obtained by the use of moving coil meters are higher accuracy and the convenience of using one meter for either direct-current or alternating-current circuits. In the instruments shown herewith the movement is mounted as a unit and can be taken from



FIGS. 1 AND 2—DETAILS OF PORTABLE METER

the dustproof case after removing the face-plate. A laminated iron shield is riveted to the aluminum mounting plate, thereby protecting the movement both from dust and from stray magnetic fields. The weight of the moving element is slight and the torque is relatively high. The pointer is of U section.

The meters attain their highest accuracy on alternating current, and are free from temperature, frequency and wave-shape errors. On direct current, the meter may be subject to slight errors due to residual magnetism of the laminated iron shield, but this can be eliminated by taking the average of reversed readings.

A contact switch operated by a button on the front of the instrument is provided on each voltmeter. The voltmeters and wattmeters are self-contained, all necessary resistors being mounted in the case. The wattmeters that have double-current or double-voltage ranges are provided with a switch operated by a knob on the face-plate, which makes the proper series or series-parallel connection of coils.

The meters are mounted in hardwood carrying cases 7.75 in. by 7.75 in. by 6.3125 in. They have hinged covers that are easily removable, and are made with flexible sole-leather handles.

A special damping sector moving in the concentrated field of a permanent magnet eliminates unnecessary wear on

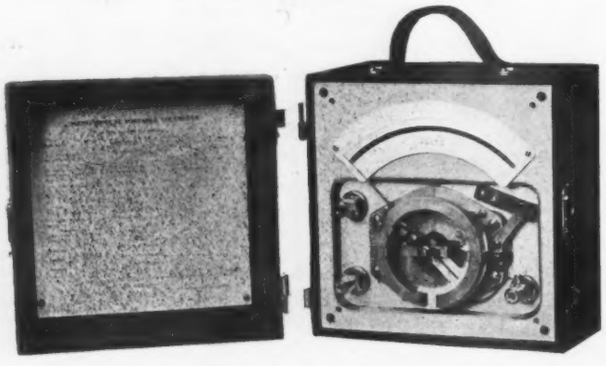


FIG. 3—PORTABLE VOLTMETER

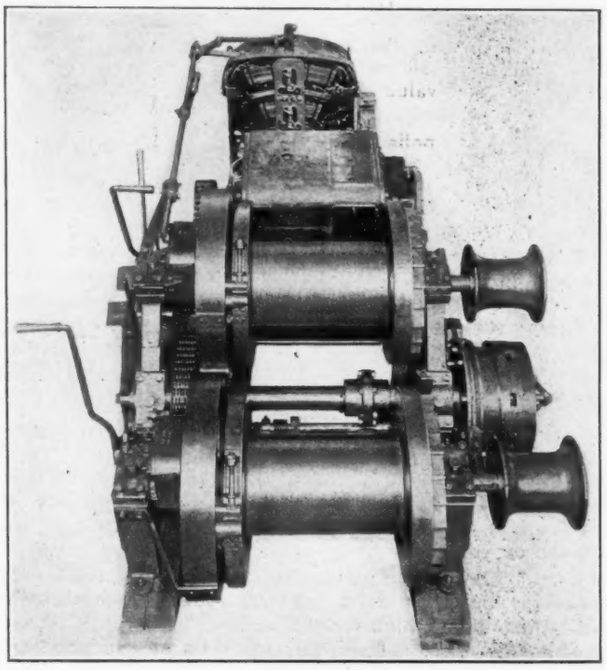
bearings. The scale covers an arc of 90 deg. and for the wattmeters the divisions are wider at the lower end, while for the voltmeters they are wider at the middle where readings are most frequently made.

These meters are being brought out by the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa.

Improved Double-Drum, Two-Speed Electric Hoist

Changing the speed of electric hoists without stopping the motor is now accomplished in an improved double-drum, two-speed type of apparatus recently brought out in Chicago. In the ordinary two-speed hoists square-jawed clutches and sliding gears are used, making it necessary practically to stop the rotation of the motor and drum to shift the gears, thereby losing valuable time in restarting. To be able to proceed from low to high speed without varying the pull on the hoist line is of particular advantage in such service as drag-line excavation and operation of clam-shell and orange-peel buckets, where heavy work under slow speed is done at the start and the emptying part of the load is light. It is also of use in steel erection where low speed is necessary at the end of the run in setting members.

Instead of the jaw clutch and gears a planetary transmission and friction clutch, similar to that used in automobile design, is used to obtain the two speeds. The chain-driven pinion on the jack-shaft is keyed to a live axle which runs to the opposite end of the shaft on which the transmission is carried. Torque is transmitted through the planetary



DOUBLE-DRUM, TWO-SPEED ELECTRIC HOIST

gears to a hollow shaft or quill, which in turn has keyed to it a driving pinion meshing with the gears on the two hoisting drums. Assuming the hoist in the low-speed position, a short movement of a speed-change lever, within easy reach of the operator, effects a special reduction of three to one. The transmission acts as a unit on high speed, giving a flywheel effect to the hoist. Inasmuch as the gears are packed in grease within a tight case the friction loss on low speed is reduced to a minimum.

Both drums are fitted with band friction brakes, thereby eliminating all side thrust, and the drums and motors are equipped with V-groove irreversible braces acting automatically.

The first hoist built went to the Indiana Sand & Gravel Company, Indianapolis, to replace a double-drum single-speed hoist operating a slack line Shearer & Mayer 1½-yd. drag-line excavator. The new hoist, which was constructed at the suggestion of Mr. R. R. Sauerman, agent for the excavator, to meet the arduous variable-load requirements of drag-line service, is now regularly built by the Thomas Elevator Company, Chicago.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Business in Small Motors and Generators Brisk.—The Fort Wayne Works of the General Electric Company, at Fort Wayne, Ind., while enjoying a very good business in all lines, are at present swamped with orders for fractional horse-power sizes of motor and generator equipment.

New Handbook on Construction Costs Imminent.—The Construction Service Company of 15 William Street, New York, in which R. T. Dana has a controlling interest, is planning to issue shortly a handbook of construction cost data along mechanical and electrical lines. It is proposed to publish this book in Chicago.

Exports of American Electrical Goods.—The exports of American-made electrical machinery and appliances in May of this year totaled in value $874,867. Of this amount $580,043 represents the value of the generator, motor and power apparatus shipped out, $87,630 that of lamp exports, and $207,194 the value of the telephone and telegraph equipment sold abroad.

Large Minneapolis Power Contract.—The Minneapolis (Minn.) General Electric Company has closed a contract with the Twin City Trading Company covering 2000 hp in motors. At present only 500 hp will be installed, but new elevators, which will be constructed within a year, will require an additional 1200 hp or 1500 hp. This contract enables the grain concern to shut down its isolated steam plant.

Condenser and Pump Sales.—A large manufacturer of pumps, condensers and other power-plant auxiliaries, interviewed recently by a representative of the *Electrical World*, stated that a good volume of business in these lines, perhaps a little larger than normal, is being handled and that this business consists almost entirely of moderate-sized orders for apparatus of standard size and design, a condition which was stated to be very satisfactory.

Electric Trucking in Manila.—The Manila Railway & Light Company, of Manila, P.I., recently placed an order for six 2-ton electric trucks with the General Motors Company through J. G. White & Company, of New York. This was its second order for this type of car, the first shipment of ten similar trucks having been made about six weeks ago. Some of these cars are to be used by the above-mentioned utility, and several of them are for use by progressive merchants in Manila.

Convention of the Federal Sign System (Electric).—The fourth annual convention of the Federal Sign System (Electric) was held recently in Highland Park, Ill., a suburb of Chicago. Branch office managers, department heads and general executives were in attendance, and three sessions a day were held, devoted to the reading and discussion of technical and business matters of interest to company representatives. The convention ended with a banquet, after which the whole party visited the Chicago factory.

American Brass Company Plans Generating System.—The Ansonia Brass & Copper Branch of the American Brass Company has recently completed the installation of two 550-kw gas-driven generating units (operating on producer gas) at its brass rolling mills at Ansonia, Conn., and it has started work and obtained part of the necessary equipment for a 900-kw water-turbine-generator installation at its copper mill in the same town. The electrical apparatus is to be supplied by the Westinghouse Electric & Manufacturing Company. A permit has been granted by the local Board of Aldermen for laying conduits to connect these two generating plants and the various mills of the American Brass Company. Arrangements will be made so that the two power plants can work either in conjunction or independently in carrying this mill load.

Linoleum Factory Gets Electric Drive.—The George W. Blabon Company, of Philadelphia, Pa., has arranged to operate its linoleum factory at Nicetown by electric drive and has ordered one 100-kva and two 500 kw alternating-current generators with 22-kw exciters and switchboard panels. Twenty-two motors ranging from 5 hp to 50 hp will be employed for operating the various machines. All the apparatus will be furnished and installed by the General Electric Company.

Peerless Company Takes Rauch & Lang Boston Agency.—The Peerless Motor Car Company of New England has secured the Boston agency for the Rauch & Lang Company, of Cleveland, Ohio, and will feature the electric vehicles under the direction of J. L. Snow at its headquarters, 660 Beaver Street, Boston, Mass. D. C. Tiffany, formerly agent for the Rauch & Lang electric car in Boston, has taken the agency for the Ohio car and will continue service for his electric garage at 136 Chestnut Street, Boston.

July Increase in Connected Load on Byllesby Properties.—During the four weeks ended Aug. 1, according to reports from all of the Byllesby properties, there was shown a net gain in electric connected load of 881 customers, representing 1163 kw in lighting, 1818 kw in motors and 1350 kw in appliances, such as flatirons, fans, toasters, percolators, vacuum cleaners and washing machines. In this period the total output of all the properties was more than 27,000,000 kw-hr., an increase of 29.7 per cent over the figures for the corresponding period in 1912.

Working on Telephone Train-Dispatching System.—The Denver & Rio Grande Railroad Company is now installing telephone train-dispatching between Ogden, Utah, and Grand Junction, Col., a distance of about 330 miles. Two No. 9 hard-drawn bare copper wires form the circuit, and selectors and telephone apparatus of the Western Electric Company's manufacture are to be used. It is expected that the first section of 114 miles, between Salt Lake City and Helper, will be put in service about Sept. 1, and the rest of the line some time in October or November.

Utilities Buy Stokers.—The American Engineering Company, of Philadelphia, Pa., has recently received orders for Taylor stoker equipment from the New York, New Haven & Hartford Railroad Company, New York; United Illuminating Company, Bridgeport, Conn.; Detroit (Mich.) Central Heating Plant; Cleveland (Ohio) Municipal Light Plant; Detroit City Gas Company, Detroit, Mich.; Interborough Rapid Transit Company, New York; Elmira (N.Y.) Water, Light & Railroad Company; Edison Illuminating Company, Lancaster, Pa., and the Detroit Edison Company.

General Electric Industrial Power Installations.—A large number of industrial power installations have been secured recently by the General Electric Company, and among these the following are important and representative: The Morse Chain Company, of Ithaca, N. Y., will add to its power plant equipment a 300-kw Curtis turbo-generator with switchboard. The Altoona Portland Cement Company, of Altoona, Kan., will install electric drive equipment, consisting of sixteen motors ranging from 15 hp to 150 hp. A 625-kva Curtis steam turbo-generator, thirty motors of from 5-hp to 50-hp rating, a switchboard and auxiliaries are to be installed in the plant of the Humboldt Cooperage Company, at Arcata, Cal. The J. G. Brill Company, of Philadelphia, Pa., big car builder, proposes to add to its power station equipment two 300-kw rotary converters, six 110-kva transformers and necessary switchboard panels. Thirty-seven new motors, ranging in size from 5 hp to 20 hp, will be placed in operation shortly by the Marion Steam Shovel Company, of Marion, Ohio.

Sunbeam Sales Conference.—The Sunbeam sales conference of the Western Electric Company was held at Nela Park, Cleveland, Ohio, during the week of July 28 and a number of prominent lamp men addressed the assembled delegates. Two sessions a day were held and the program included talks on the lamp situation from sales, publicity, commercial and technical standpoints. Particular attention was paid to the questions of tungsten sales stimulation, co-operation between the sales and engineering departments and the introduction of Sunbeam lamps into industrial plants.

New Electrical Equipment for a California Utility.—The San Joaquin Light & Power Corporation, of Fresno, Cal., will add to the equipment of its power station 3000-kva and 3750-kva alternating-current generators with two 80-kw turbo-exciters and a 50-kw motor-generator exciter, four 666-kva and four 1000-kva water-cooled transformers, a 100-kw motor-generator set and necessary switchboard panels. The order also includes four 1250-kva water-cooled transformers and switchboards for the stations at Bakersfield and Friant, Cal. All the apparatus will be built by the General Electric Company.

Electrical Hand Lantern Selling Well.—The Jenks Lantern Company, of 3 North Clark Street, Chicago, Ill., states that it is receiving large orders for its recently perfected electric hand lantern. The lantern consists of a 3½-volt, 1½-cp incandescent lamp, supplied from three dry cells carried in the base. The battery is guaranteed to give fourteen hours' continuous service or its equivalent in intermittent use. The lamp resembles in design the old oil lantern and is bail-operated; that is, with the bail vertical, as when in use, or with it hanging on one side, the lamp is lighted; when hanging on the other side the light is extinguished. This lamp is adapted to the same service as the old oil lantern.

Solderless Connectors Used in Wiring Large Hospital.—A large order for solderless connectors was recently placed with Dossert & Company, of New York City, for the wiring of the new General Hospital in Cincinnati, Ohio, the work being done by the William A. Corrao Company, of St. Louis. Not only were Dossert connectors specified for the switchboard wiring and for making the tap-offs from feeders, but special Dossert type B lugs were attached to the ends of the large feeder cables ranging up to 1,500,000 circ. mils, for the purpose of pulling in the cables. This method of pulling cables through conduit was first used by the Thompson-Starrett Company in wiring the Gimbel Building, Broadway and Thirty-third Street, New York.

Electrics in High Favor on the Pacific Coast.—A tire manufacturer who returned from a visit to the Pacific Coast recently expressed himself on the outlook for electric vehicle business in the West as follows: "At present both the electric pleasure car and commercial car hold an eminent position. The excellent roads throughout the Pacific Coast, especially in California, afford bright prospects for this type of machine. The Western States along the Pacific Coast raise an enormous quantity of fruit. The rapidity with which fruit products can be delivered to shipping points by trucks is appreciated by the fruit growers, as they fully realize that their product is one of perishable nature. The continuance of the good roads policy is bound to establish this section of the United States as the largest user and possibly producer of electric vehicles."

Kansas Utility Increases Its Generating Capacity.—The Kansas City (Mo.) Terminal Railway Company is increasing its generating capacity by the construction of a new power house, measuring 184 ft. by 94 ft., with a brick stack 14 ft. in diameter at the top and 250 ft. high. The boiler room is laid out to accommodate eight 500-hp Babcock & Wilcox horizontal water-tube boilers, and six of these will be installed at once. These are to be equipped with superheaters and chain-grate stokers of the same make and will have high reverse settings, giving large combustion chamber and smokeless operation. Worthington feed-water pumps are to be put in, driven by Kerr turbines. The present installation of electrical equipment will consist of two 1250-kva General Electric horizontal turbo-generators, three-phase, 60-cycle, 3600-r.p.m., and one 35-kw, 120-volt exciter. Two absorption-type refrigerating machines are also to be installed, with a combined capacity of 75 tons. The power plant will be equipped with coal and ash-handling machinery, reserve fire and elevator pump, house-service pumps and crane. The service wires and piping to the station building and other points will be carried through an underground tunnel.

New Type of Drawing Tables to Be Marketed.—The Economy Drawing Table Company, of Toledo, Ohio, has decided to manufacture and carry in stock an iron-base, adjustable-type drawing table, in addition to its regular line of drawing tables and filing cases which has become known as the "Economy" furniture. Some entirely new devices on this adjustable table will enable the draftsman to make the adjustment easily and quickly from the front of the table, and also to fix the top firmly at any height or angle desired.

Indirect Lighting in Newark, N. J.—Speaking of the question of indirect lighting and its special availability for certain classes of illumination work, H. R. Jackson, of Newark, N. J., recently stated to an *Electrical World* representative: "There is no question in my mind but that in the near future this system will be used for lighting all banking and commercial offices, and to a considerable extent in private residences." At the office of the Federal Trust Company in Newark there have been installed recently ten indirect-lighting units. Each consists of a bowl 24 in. in diameter, containing a 500-watt lamp and suspended 3 ft. 6 in. below a 20-ft. ceiling. The fixtures were supplied by the Alexalite Company, of 432 East Twenty-third Street, New York. The space lighted by these units measures 25 ft. by 100 ft., and the installation has given such satisfaction that three other Newark concerns, the Washington Trust Company, Fidelity Trust Company, and Liberty Trust Company, have placed orders for similar equipment. On these last-named jobs the units will contain 250-watt lamps and the fixtures are to be supplied by Cassidy & Son, of 133 West Twenty-third Street, New York. The installation at the Federal Trust Company's office replaced about a hundred individual desk lights, and it is estimated that the cost for energy will be about the same as with the old system, but the illumination is said to be so much superior to that formerly obtained as to be beyond comparison. These four installations were all awarded to the above-mentioned contractor.

Chicago Jobber on Trade Conditions.—According to the Central Electric Company of Chicago, Ill., the most radical change that has been made for a long time in the sale of electrical goods is that put in force recently by the National Tube Company. That company has applied (*Electrical World*, Aug. 2) to electrical conduit of its manufacture list prices and discounts that have governed the sale of wrought iron or merchant pipe for a number of years. By this plan the weight per 100 ft. determines the list price, and instead of a basic discount of 50 per cent and a number of tens and fives additional, a discount of usually only two figures is employed. The National Tube Company's active entrance into the conduit field was unexpected, as was also the change in the method of pricing, and it is hoped that the new arrangement will be a vast improvement over the past uncertain and unstable practice. Of great moment also at the present time in electrical lines is the general reduction in profits and the increase in operating expenses, the former due to the indifference on the part of many manufacturers and jobbers to the necessity of an average percentage of profit that will be in accord with the expense of doing business, and the latter to the fact that keen competition has reduced the size of orders and increased their number, necessitating the handling of ten transactions or orders instead of one. Necessary increases in salaries, hotel and other expenses have also put the selling cost far beyond old figures. The company maintains that many buyers of electrical material fail to realize that this extra service must be paid for and are therefore surprised when they discover that prices which do not include an average profit to the seller always carry a penalty to the buyer in the shape of slow deliveries, poor quality goods or both. The company is of the opinion that the time is not far away when the buyer will be keenly interested in the seller making a profit; when, in fact, the buyer will not do business with a concern that disregards profit.

Electrical Industry from a Western Viewpoint.—The Automatic Electric Washer Company, of Newton, Ia., has implicit faith in the future of the electrical industry in this country, as witness the following abstract of a letter recently received from that company: "While no doubt many of our Eastern customers wonder why we are located 'way out here in the West on the prairie,' it is nevertheless true that we are supplying some of the largest holding and operating companies in the country. They no doubt find that our machine pleases their customers or they would not recognize it as they do. We regard it as merely a question of time when this entire country will be electrified and every farmhouse will be an electric 'prospect.' The wonderful engineering achievement at Keokuk will make cheap power possible within a large radius."

Relief Promised to Stockholders.—Immediate payment of interest on deferred payments of stock of the St. Joseph (Mo.) Railway, Light, Heat & Power Company has been offered to holders who deposited stock with the Fidelity Trust Company, in accordance with an offer of purchase made by Henry L. Doherty & Company upon condition of a new plan of extending payments.

Controversy Over Utility Taxation in Colorado.—The taxation valuation of the Denver Gas & Electric Light Company, which is operated by the Cities Service Company, was placed at $2,777,730 by the Colorado tax commission and later reduced to $1,784,020 by the commissioners of the city of Denver. Suit has been brought by the former commission against the latter to enjoin it from taking this action. Court proceedings came about through a conflict as to jurisdiction of the two commissions and will probably result in a long-drawn-out controversy. In the meanwhile it is learned that the company, which is controlled by the Henry L. Doherty interests in New York, has paid its taxes on the valuation of the city commission.

Lansden Company Failure.—The Lansden Company ,of Newark, N. J., and Allentown, Pa., manufacturer of electrical vehicles, filed a schedule in the Bankruptcy Court in Newark on Aug. 8, showing claims amounting to about $193,000, held by 300 or more creditors, and assets of $304,046. Of the latter item a very large proportion is represented by manufactured product at the two above-named plants, totaling in value $118,178. The assets include also $32,516 in bills receivable. The largest creditors are the Merchants' National Bank of Jersey City, which has a claim of $30,428, partly secured; the Edison Storage Battery Company and the General Electric Company, whose combined claims total about $30,000, and the North Ward National Bank, whose claim of $12,500 is unsecured. The company was organized in 1904 by Thomas A. Edison, and in January, 1912, control of it passed into the hands of W. L. Case and interests represented by him, as recorded in the *Electrical World* of Feb. 3, 1912. At this time the capital was increased from $100,000 to ten times that amount and a new factory was leased in Newark. In June of the present year the company acquired the plants of the Webb and the Mack Brothers companies at Allentown, Pa., and established a branch at that place, moving to it part of the equipment of the Newark plant. Notice of this change appeared in the May 31 issue of the *Electrical World*. The company consented to an immediate adjudication of the above claims upon the filing of a bankruptcy petition by the Crescent Auto Company, of New York. George Paddock, of the Paddock-Zuzi Motor Company, is the receiver.

The Copper Situation.—During the last half year there have been several unusual factors affecting the copper situation in this country, the presence of which has been reflected in the figures on production and consumption. A period of great activity in business at the start of the year, followed by a decided slump (arising apparently from a combination of tariff and currency legislation agitation and from the Mexican and Japanese complications), caused tightness in the money market, which was very generally felt throughout the country. Following closely on the heels of this interval of financial gloom came labor trouble at the large Nichols refinery, and later a strike at the Lake mines, which is still in effect, and when the Nichols plant did finally get into operation one of the big furnaces broke down, holding up the delivery of probably 10,000,000 lb. of copper during July. As a result of these and other unfavorable local conditions, and following an increase in the volume of imports and a falling off of exports, copper prices were forced down to a fairly low figure, reaching during one week in July as low as 13.25 cents for spot. A number of big buyers held up their purchases at this time, because of money tightness and also in accord with the general belief that prices would go still lower. As it turned out, however, 13.25 cents proved to be about the low-water mark, and the period of depression was followed by a gradual increase in prices for all grades, an effect possibly attributable, in some measure at least, to the fact that the big electrical manufacturers, which are large consumers of copper, have lately enjoyed unparalleled activity. The present market is quiet and is expected to remain so through August. Statistically the copper situation is strong, the prospects are good for a steady, large consumption, and money is getting easier. There is a fear expressed in some quarters that the recent labor troubles have resulted in too great depletion of the reserve stocks, but no immediate trouble from this source is to be expected. September should, according to present indications, bring a period of renewed activity.

Statement of the Copper Producers' Association for July

The big slump in domestic copper deliveries during July is summed up in the totals for that month, as follows:

	July, pounds		June, pounds	
Stocks on hand in the United States on first of month		52,904,606		67,474,225
Production		138,074,602		121,860,853
		190,979,208		189,335,078
Domestic deliveries	58,904,192		68,362,571	
Foreign deliveries	78,480,071		68,067,901	
		137,384,263		136,430,472
Stocks on hand at end of month		53,594,945		52,904,606

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	Aug. 6	Aug. 13
Allis-Chalmers, t.r., 5th pd	$19,800,000	.....	.....	9	8½*
Allis-Chal., pf.,t.r.,5th pd.	16,050,000	.....	.....	16½	16½*
Amalgamated Copper	153,887,900	1½	Q	70½	74½
American Tel. & Tel.	344,471,400	2	Q	128½	129½
Electric Storage Battery,c.	16,074,425	1	Q	48	48
General Electric	101,363,600	2	Q	141	142½
Mackay Cos., c.	41,380,400	1½	Q	89	89*
Mackay Cos., pf.	50,000,000	1	Q	66	67*
Western Union Tel.	99,747,600	¾	Q	67	68
Westinghouse, E. & M., c.	34,496,400	1	Q	63½	68
Westinghouse, E. & M., pf.	3,998,700	1¾	Q	114	114*

*Last price quoted.

NEW YORK METAL MARKET PRICES

	Aug. 5		Aug. 12	
	Bid.	Asked.	Bid.	Asked.
Copper:				
Standard, spot*	14.37½	.....	14.72½ to 15.85	
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard, spot*	67 17 6		69 0 0	
Prime Lake	15.25	to 15.37½	15.75	to 15.87½
Electrolytic	15.12½	to 15.25	.....	15.75
Casting	14.87½	to 15.00	.....	15.50
Copper wire base	16.25	to 16.37½	16.75	to 17.00
Lead	4.50		4.50	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f. o. b. smelter	7.50		7.50	
Spelter, spot	5.60	to 5.65	.....	5.75
Tin, spot*	40.80	to 40.87½	41.75	to 42.00
Aluminum:				
Prompt delivery	22.75	to 23.25	22.75	to 23.25
Future	21.00	to 22.00	21.00	to 22.00

*OLD METALS

Heavy copper and wire	13.75	14.50
Brass, heavy	8.75	9.25
Brass, light	7.75	8.25
Lead, heavy	4.40	4.40
Zinc, scrap	4.25	4.62½

*COPPER EXPORTS

Total tons to Aug. 17 12,929

*From daily transactions on the New York Metal Exchange.

Business Notes

Imperial Electric Company.—Mr. H. A. Truitt has purchased the interest of Mr. Thomas G. Truitt in the Imperial Electric Company and will continue the business of this company at 1022 Arch Street, Philadelphia, Pa. The company will act as distributing agent for the Franklin Electric Manufacturing Company, Hartford, Conn., and the Empire Lamp Works, of New York.

Manning, Maxwell & Moore, Inc., together with their subsidiary companies, will move their general offices about Oct. 1, from 85-89 Liberty Street to the new Lewisohn Building, 113-119 West Fortieth Street, New York. This change is being made to meet the demand for a more convenient and central location, as well as for larger space to handle material increases in the company's various lines, which include electric traveling cranes, machine tools, engineering specialties, and railway, machinists', engineers', factory and contractors' supplies. A large portion of this product is manufactured by their constituent companies, the Shaw Electric Crane Company, the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, the Hayden & Derby Manufacturing Company, and the Hancock Inspirator Company. Manning, Maxwell & Moore, Inc., will occupy the twentieth and twenty-first floors of the new building, which will give them 28,000 sq. ft. of office space, almost double that at present occupied for offices on Liberty Street.

New Industrial Companies

The Karkas Lamp & Wire Company, of Hoboken, N. J., has been incorporated by Maurice J. Breen, William H. McTigue and David Lubach. The company is capitalized at $125,000 and proposes to manufacture incandescent lamps.

The Thermo Electric Instrument Company, of Newark, N. J., has filed articles of incorporation with a capital stock of $100,000. The company proposes to manufacture and deal in electric ovens and other electrical devices. S. Lawrence Miller is one of the incorporators.

The Monmouth Electric Company, of New York, N. Y., has been incorporated by C. H. Hopper, M. H. Hopper and C. Meyer, all of 92 Murray Street, New York, N. Y. The company is capitalized at $10,000 and proposes to manufacture and deal in electrical goods.

The Electric Device Company, of Logan, Utah, has been incorporated with a capital stock of $10,000 for the purpose of dealing in electrical devices. The officers of the company are: Thomas G. Lowe, president; D. S. Betts, vice-president, and F. L. Jensen, secretary and treasurer.

The National Rotary Power Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000. The incorporators are: G. G. Steigler, C. L. Ward and M. Z. Grubb, of Wilmington, Del.

Trade Publications

Generators for Electrolytic Work.—Bulletin A-4093, recently issued by the General Electric Company, illustrates and describes its generators for electrolytic work.

Lightning Arresters for Electric Railways.—Bulletin No. A-4135 of the General Electric Company refers to lightning arresters for electric railways and supersedes a previous bulletin on the same subject.

Prism Fixtures.—A twelve-page booklet, issued by the F. W. Wakefield Brass Company, Vermilion, Ohio, shows a number of distinctive designs of Colonial prism fixtures. Renewed interest in prism glassware has caused the new line to be placed on the market.

Storage Batteries.—In Handbook FL, which is a supplement to its Handbook HL, the Electric Storage Battery Company, Philadelphia, Pa., gives many valuable data relating to batteries for low-voltage isolated electric plants. The batteries operate at from 32 volts to 28 volts.

Heating Devices.—In a well-illustrated mailing folder now being sent to dealers in electric-heating devices the Hotpoint Electric Heating Company, Ontario, Cal., lists and describes stoves, irons, toasters and various other electric-heating devices. A thirty-day free display of an electric stove is made to dealers who will agree merely to act as agents in introducing the stove to the local public.

Automatic Starters.—A bulletin of the General Electric Company, No. A-4124, is devoted to a detailed description of its automatic starters for alternating-current motors. Descriptions are given of automatic control panels for squirrel-cage induction motors and slip-ring induction motors, float switches for remote control of automatic starting panels or rheostats, and pressure governor panels.

Auto Fuse Material.—The Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, is sending out an illustrated leaflet referring to its auto fuse material. In the circular attention is called to the fuse box which centralizes the fuse cut-outs in an accessible position. The circular will interest electrical jobbers and wholesale and retail automobile supply manufacturers and dealers.

Good Light.—The Macbeth-Evans Company, Pittsburgh, Pa., has issued a booklet of twenty-four pages, with the title "Good Light," giving in a succinct and interesting manner the essentials that form the basis of a satisfactory lighting system. The photographs of typical installations showing an application of these essentials are admirable and convey a good idea of the possibilities of efficient decorative illumination.

Diesel Engines.—Usines Carels Frères, the big Diesel engine makers of Ghent, Belgium, have put out a handsome new catalog—the first printed in English—describing their product. A brief history of this engine is given, followed by an exposition of its working principles. In the frontispiece is given an impression of the Carels shops in color, and the rest of the pamphlet is copiously illustrated. The whole thing is a work of art and of information.

Rail Bonds.—The Electric Service Supplies Company, Philadelphia, has issued an attractive seventy-two-page catalog referring to its protected rail bonds and appliances. The catalog gives comprehensive information on the value of proper installation of rail bonds, the importance of accurate testing apparatus aand the use of bond compressors. Because of the practical information contained in this publication it will be found of interest and value to operating men.

Direct-Current Motors.—The General Electric Company has issued Bulletin No. A-4130 describing its adjustable speed direct-current motors. These are designed to meet the requirements of individual drive of machine tools. The bulletin illustrates these motors and their application in detail, and contains various curves showing the horse-power outputs at speeds of 300 to 900, 400 to 1200, 500 to 1500 and 600 to 1800 r.p.m. and the horse-power each motor will develop at intermediate speeds.

Receiver Separators.—Catalog B of the Harrison Safety Boiler Works, Philadelphia, contains an illustrated description of high-pressure separators equipped with wells or receivers of large capacity not only for the purpose of storing exceptional amounts of water, but also to serve as a reservoir for the storage of steam between the intervals of opening of the engine admission valve. A chart is given showing the most economical diameter of piping, assuming coal at $3 per ton and uniform flow, as where receiver separators of large capacity are installed.

Economy and Efficiency in the Operation of Utilities.—Under the heading of "The Efficiency Movement" the department of examinations and reports of H. M. Byllesby & Company, Chicago, has issued its department bulletin No. 6. The purpose of the circular is to point out that under modern conditions, and the increasingly close supervision by state commissions and municipal bodies, utility companies find it of the greatest importance to operate economically and efficiently. Scientific means must be employed to prevent unfair rate reduction and to secure equitable rate schedules. The department of examinations and reports offers its services to develop efficiency, to make appraisals, or to deal with sales methods or problems of a financial nature arising in utility management.

Personal Mention

Mr. George Brockman has resigned as superintendent of the Herington (Kan.) municipal water and light plant.

Mr. C. R. Vincent has succeeded Mr. M. D. Leslie as superintendent of the Osceola (Mo.) Electric Light Company.

Mr. J. C. Anderson has succeeded Mr. T. T. Kruger as superintendent of the municipal electric-lighting plant of Peru, Ind.

Mr. L. A. Baldwin has succeeded Mr. Edwin Fisher as president of the municipal electric-light and water plant at Coldwater, Kan.

Mr. D. J. Fleming has been appointed manager of the Red Wing (Minn.) Gas Light & Power Company, succeeding Mr. Adolph Wagner.

Mr. George F. Cooper has been appointed successor to Mr. J. E. Pappan as auditor of the Knoxville (Tenn.) Railway & Light Company.

Mr. F. H. Smith has taken the place of Mr. E. W. Smyth as vice-president of the Franklin Springs Electric Light Company, of Clinton, N. Y.

Mr. Roy W. Wright has been appointed superintendent of the municipal electric-light plant at Lydon, Kan., as successor to Mr. J. R. Bortle.

Mr. G. A. Rodenbeck has succeeded Mr. E. B. Stanley as secretary and treasurer of the Franklin Springs Electric Light Company, Clinton, N. Y.

Mr. A. C. Herren has been appointed superintendent of the municipal electric lighting and water plant of Tipton, Ind., succeeding Mr. N. Hiatt, resigned.

Mr. J. W. Carruthers has been elected president of the Montague (Prince Edward Island, Canada) Electric Company as successor to Mr. W. L. Poole, resigned.

Mr. A. Strohm has been appointed superintendent of power and equipment of the Warren (Pa.) & Jamestown Street Railway as successor to Mr. R. Endinger.

Mr. A. E. Berdon, formerly chief engineer of the Easterline Company, Indianapolis, Ind., and designer of graphic meters, has severed his connection with that company.

Mr. Samuel C. Shaffner has resigned as operating engineer for the American Public Utilities Company, Grand Rapids, Mich., to accept a position with an operating and engineering company.

Mr. Elmer G. Stahl has been appointed superintendent of the municipal electric-light plant at Topeka, Kan., succeeding Mr. G. G. O'Neill. Mr. Stahl is a graduate of the Kansas State Agricultural College.

Mr. Montague Ferry, of the Department of Electricity of the city of Chicago, has been appointed municipal telephone supervisor. He will have charge of the recently created bureau of telephone complaints.

Mr. Justin W. Lester, of the Old Colony Trust Company, Boston, Mass., has been appointed chief accountant of the Massachusetts Public Service Commission, with headquarters at 20 Beacon Street, Boston.

Mr. Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, sailed from New York on Aug. 9 for a five weeks' tour of Europe. While there he will visit the foreign subsidiaries of the company.

Mr. Arthur J. Cantin has been appointed superintendent of the electric light and power department of the town of Melville, Sask., Canada. Mr. Cantin was formerly connected with the Gorman, Clancey & Grindley sales engineering staff at Edmonton, Alberta.

Mr. W. L. Abbott, chief operating engineer for the Commonwealth Edison Company, was one of the experts called in to give testimony before the legislative committee investigating the purchase of voting machines by the election commissioners of Chicago.

Mr. B. T. Gifford, formerly connected with the American District Steam Company of North Tonawanda, N. Y., has been appointed operating engineer for the American Public Utilities Company, of Grand Rapids, Mich., as successor to Mr. S. C. Shaffner, resigned.

Mr. Frank H. Evans has been appointed commercial agent of the La Crosse (Wis.) Gas & Electric Company. Mr. Evans has been connected with the Public Service Gas & Electric Company, of Plainfield, N. J., in various capacities for the past six years, being new-business manager at the time of his resignation. The La Crosse Gas & Electric Company has handled only gas appliances until recently. It now intends to put in fully equipped display rooms, etc.

Mr. S. W. Cheney has been appointed assistant engineer of Kelsey, Brewer & Company, with headquarters at Grand Rapids, Mich. Mr. Cheney leaves the position of engineer and general superintendent of the La Crosse (Wis.) Gas & Electric Company, which he has filled for the past four months. He has been identified with public utility industries since his graduation from the University of Wisconsin in 1904, and has filled responsible positions at Denver, Col.; Lincoln, Neb.; Montgomery, Ala., and with the Railroad Commission of Wisconsin.

Mr. A. W. Higgins has been appointed engineer and general superintendent of the La Crosse (Wis.) Gas & Electric Company. Mr. Higgins has been doing engineering work of various kinds since graduating from the Massachusetts Institute of Technology in 1901. He has been associated with the E. H. Abadie Company, St. Louis, Mo., engineer and contractor, and more recently was in charge of the installation of the new power plant for the Big Muddy Coal & Iron Company, of Herrin, Ill. Mr. Higgins succeeds Mr. S. W. Cheney, who goes to the home office of Kelsey, Brewer & Company, at Grand Rapids, Mich., who operate the La Crosse property.

Mr. Stephen L. Coles has been appointed acting secretary-treasurer of the Society for Electrical Development, vice Mr. Philip S. Dodd, resigned. As announced in these columns several months ago, Mr. Coles' services were retained by the society as director of publicity. For the past four months the society has loaned Mr. Coles to the Toronto Electric Light Company, Ltd., of Toronto, Ontario, where he has been engaged in constructive service and advertising problems. Mr. Coles has had twenty-five years' experience in daily newspaper, magazine, weekly and advertising agency work, and was for several years managing editor of the *Electrical Review*. His electrical education was obtained at the Massachusetts Institute of Technology and in the field during the formative period of the electrical industry.

Mr. C. A. Graves has resigned his position as manager of the power bureau of the sales department of the Edison Electric Illuminating Company of Brooklyn to engage in consulting engineering work. Mr. Graves has organized the Graves Engineering Company, Inc., with offices at 35 Pine Street, New York City, and will specialize in central-station management and sales campaigns in small communities. In addition to his connection with the Brooklyn Edison company Mr. Graves has been president and active executive of a central station in central New York for the past three years, in which venture he has met with marked success. His connection with the Brooklyn Edison company runs back nine years, during which time he secured many of the large industrial contracts. In addition, he has acted as rate expert. Mr. Graves has been active in the affairs of the National Electric Light Association, having served on the gas-engine committee and on the power committee. He has also taken a prominent part in Brooklyn civic and engineering associations. He is a member of the Brooklyn Engineers' Club, the Electrochemical Society and the Beta Theta Pi Club and an associate in the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

C. A. GRAVES

Construction

New England

KEZAR FALLS, MAINE.—The Cornish & Kezar Falls Lt. & Pwr. Co., of Kezar Falls, expects to erect a new power station within the next three months. The equipment will be taken from the present power house, replacing such new parts as are necessary. Allen Garner is president and manager.

SPRINGFIELD, VT.—The Colonial Pwr. & Lt. Co., of Springfield, expects to erect within the next two months a 44,000-volt transmission line from Springfield to Rutland, Vt., connecting with Claremont, N. H., line at Cavendish, Vt. The company has just completed a line from Springfield to Chatham, N. H., connecting with the Bellows Falls, El. Co. J. G. Menut is manager.

EVERETT, MASS.—Plans are being considered by Alderman Ferguson for the installation of an ornamental street-lighting system on Broadway from the Revere Boulevard through Central Square to Glendale Square. The committee on municipal lighting of the Board of Trade is also interested in the project.

PEABODY, MASS.—The municipal electric-light plant was destroyed by fire on Aug. 8, causing a loss of about $50,000. Arrangements are being made to secure electrical service from the Salem El. Ltg. Co. of Salem.

SOUTHBRIDGE, MASS.—The Selectmen have signed a contract with the Webster & Southbridge Gas & El. Co. for the installation of a new street-lighting system on Main Street for a period of 10 years at $1,350 per year.

WALTHAM, MASS.—The special aldermanic committee appointed some time ago to make investigations in connection with the street-lighting problem will also consider the question of establishing a municipal lighting plant as well as the plan suggested by the Edison El. Illg. Co. for replacing the arc lamps now in use with new lamps throughout the city.

WESTERLY, R. I.—The Westerly Lt. & Pwr. Co. expects to erect within the next six months a substation at Westerly to distribute energy in Bradford and Watch Hill, R. I., and Stonington and Mystic, Conn. In the near future the company expects to replace the arc lamps now in use with cluster lamps, except in the main part of the town, where the flaming-arc lamp will be installed. The company has installed at White Rock, in the substation of the Norwich & Westerly Trac. Co., a 400-kw frequency changer and is now purchasing part of its energy from the traction company. M. H. Spellman is general manager of the Westerly company.

CHESTER, CONN.—At a special town meeting held recently the Selectmen were authorized to make a new contract for street-lighting for a period of five years. The new contract calls for 50 lamps at $1,025. At present the town is paying $750 per year for 30 gas lamps.

SOUTH NORWALK, CONN.—The city of South Norwalk Electric Works expects to purchase in the near future about 12,000 ft. of weather-proof No. 0000 copper line wire and some other sizes. The city may take up ornamental street lighting to some extent next year. A. E. Winchester is general superintendent.

Middle Atlantic

BROOKLYN, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, until Aug. 19, for furnishing labor and material necessary to reset 12 horizontal tubular boilers in the power house at the Kings County Hospital, borough of Brooklyn. Blank forms and further information may be obtained at the office of the chief engineer of the department, foot of East Twenty-sixth Street, New York, where plans and specifications may be seen. Michael J. Drummond is commissioner.

EAST HAMPTON, N. Y.—The East Hampton El. Lt. Co. has received authority from the Public Service Commission to issue $2,500 in bonds, the proceeds to be used for improvements to its property.

ELMIRA, N. Y.—Plans are being prepared by the Lackawanna R. R. Co. for the construction of an electric power plant in its yards here. The proposed plant will furnish electricity for lighting the station, yards and office buildings in addition to charging electric batteries in passenger coaches.

NEW YORK, N. Y.—Bids will be received by Joseph Johnson, fire commissioner, at the headquarters of the Fire Department of the city of New York, 157 and 159 East Sixty-seventh Street, borough of Manhattan, until Aug. 19 for furnishing all labor and materials required for the extension to the fire-alarm telegraph system in the borough of the Bronx. Blank forms and further information may be obtained and plans and drawings may be seen at the office of the Bureau of Fire Alarm Telegraph of the Fire Department, 157 and 159 East Sixty-seventh Street, Borough of Manhattan.

NEW YORK, N. Y.—Bids will be received by the Board of Water Supply, seventh floor, 165 Broadway, New York, until Sept. 2 (contract 56) for installing a hydroelectric power equipment, of approximately 250 kw rating, at the lower gate and screen chambers of the Ashokan reservoir in the town of Olive. Pamphlets containing information for bidders, forms of proposal, contract specifications, contract drawings, etc., can be obtained upon application to the above office. A deposit of $10 will be required for each pamphlet, to be refunded upon return of same. Joseph P. Morrissey is secretary.

NEW YORK, N. Y.—Bids will be received at the office of the Board of Water Supply, seventh floor, 165 Broadway, New York, until Sept. 2 (contract 153) for furnishing and delivering a complete portable power plant, consisting of a gasoline or oil-driven motor-generator set, a switchboard and one motor-driven air compressor, at a designated locality along the line of the Catskill Aqueduct. Pamphlets containing information for bidders, forms of proposals and contract, specifications, etc., can be obtained at the above address. A deposit of $5 will be required for each pamphlet, to be refunded upon return of same. Joseph P. Morrissey is secretary.

NEW YORK, N. Y.—Ordinances have been approved by the Board of Aldermen and the Mayor authorizing an appropriation of $50,000 to provide funds for the installation of electric wiring and fixtures at the City Hospital, Blackwell's Island; $35,000 for electric wiring and fixtures at the City Home, Blackwell's Island; $10,000 for additional electric-lighting facilities at the Kings County Hospital; also $20,000 for the construction of a tunnel, ducts, etc., to connect New York Farm Colony with Sea View Hospital power plant, borough of Richmond, and $20,000 for the installation of water mains, hydrants and electric wiring at New York City Farm Colony, borough of Richmond, all under the jurisdiction of the Department of Charities, foot of East Twenty-sixth Street.

PATCHOGUE, N. Y.—The Village Trustees have awarded the contract for street lighting to the Patchogue El. Lt. Co. for a period of five years. Under the terms of the contract the company agrees to furnish 100 tungsten lamps of 40 cp at $20 each per year and 50 lamps of 60 cp at $23 per lamp per annum; also 12 arches (consisting of 22 lamps of 4 cp) across Main Street and Ocean Avenue for $47.50 each per year, making a total of $3,600 per year. Under the old contract the village paid $20 each for lamps of 20 cp.

GROVE CITY, PA.—Within the next six months the managers of the municipal electric-light plant expect to purchase one 250-hp gas engine and one 175-kw, three-phase, 60-cycle, 2300-volt generator with complete switchboard equipment for same. Paul J. Hays is superintendent of the plant.

HONESDALE, PA.—The Honesdale Consol. Lt., Ht. & Pwr. Co. expects to erect within the next two months one series incandescent circuit, consisting of 26 40-watt lamps.

PHILADELPHIA, PA.—Bids will be received at the Department of Supplies, Room 312, City Hall, until Aug. 19 for furnishing the following supplies during the year 1913: Electric lamps and cable for the Electrical Bureau and rubber valves for the Bureau of Water in accordance with schedules which may be seen at place designated on proposal form. Herman Loeb is director.

PHILADELPHIA, PA.—Plans are being prepared by the Philadelphia El. Co. to increase the output of its generating plant; also to erect a new substation at Sixty-fifth Street and Paschall Avenue, to distribute energy to plants in West Philadelphia, Chester and Delaware Counties. A substation at Marcus Hook is to provide power for the silk factory of the American Vicose Company at that place, and another substation at Chester will furnish electricity for the Chester Solid Steel Casting Co.'s rolling mill and other industrial plants. The company is also planning to enlarge its Christian Street power plant, in which two new turbo-generators (one of 47,000 hp and the other of 41,000 hp) will be installed next year.

ASBURY PARK, N. J.—The Atlantic Coast El. Lt. Co., of Asbury Park, has submitted a proposition to the City Council offering to install and maintain 15 arc lamps on Oak Bluff Avenue for a period of five years at $95 each per year.

BALTIMORE, MD.—Bids will be received by the Board of Awards of Baltimore City at the office of the city register, City Hall, Baltimore, until Sept. 10 for furnishing and erecting electrical equipment for filtration plant (contract No. 20, Water Department) as follows: four 400-kva transformers, one 50-kva transformer, circuit-breakers and high-tension switchboard, one nine-panel, low-tension switchboard, all wiring and starters for connecting up various motors; also for furnishing the following motors: one 400-hp motor, two 350-hp motors, one 250-hp motor, one 75-hp motor and three 50-hp motors. Plans and specifications may be obtained at the office of the water engineer, City Hall, Baltimore. A charge of $5 will be made for each set of plans and specifications, which will be refunded upon return of same before Sept. 6. Ezra B. Whitman is water engineer, and James H. Preston is president of board of awards.

EMMITSBURG, MD.—The Public Service Commission has granted the Emmitsburg El. Co. permission to issue $7,500 in capital stock and to begin construction of its plant. The company will furnish electricity in Emmitsburg.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Aug. 21, for furnishing to the Signal Corps 200 telephones, field-artillery type, model 1912, with 5-ft. cords and plugs connected at each end, in accordance with specifications 535-C. Major W. L. Clarke is disbursing officer.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Room 509, District Building, Washington, D. C., until Aug. 21 for furnishing 29,000 ft. underground signal and telephone cable for use by the Electrical Department of the city. Specifications and form of proposal may be obtained from the purchasing office of the district of Columbia, Room 320, District Building, Washington, D. C.

WASHINGTON, D. C.—Bids will be received by the Department of the Interior, Washington, D. C., until Sept. 2 for installing or placing in position in the patent office, old post office and pension buildings at Washington, D. C., stationary chemical fire-extinguishing apparatus, including complete electrical operating alarm and annunciator systems and piping, etc., for said apparatus. Blank forms of proposal and specifications may be obtained on application to Lewis C. Laylin, assistant secretary.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Aug. 23 for furnishing to the Signal Corps the following supplies: (1) 10,000 oak brackets, as per drawing 207 b-1; (2) 350 cells, type V, complete, as per specification 341-D; (3) 7000 double-petticoat glass insulators; (4) 500 porcelain knobs No. 14; (5) 270 miles C. I. 144-mil wire (commercial standard); (6) 2000 ft. pothead 33-mil wire (commercial standard, A., T. & T. specification). Bids will also be received until Aug. 27 for 300 miles of 11-strand field wire, in accordance with specification No. 403-A and drawing No. 106. Major W. L. Clarke is disbursing officer.

North Central

BELDING, MICH.—A complete power plant, it is understood, will be installed in the Belding Brothers Building, now in course of construction.

BENTON HARBOR, MICH.—The Benton Harbor Club is promoting a project to install ornamental street lamps on 12 blocks. For further information address the secretary of the club.

DETROIT, MICH.—The Detroit Oak Belting Co. is reported to have awarded contracts for a generator and motors to be installed in its boiler plant.

DOWAGIAC, MICH.—The Beckwith Estate, electric light department, of Dowagiac, expects to purchase within the next six months feed-water heaters; also within the next twelve months fifty 1-kva to 5-kva transformers, 100 5-amp meters, 10,000 ft. No. 1014 rubber-covered wire, 7500 lamps, 100 irons and other heating devices, 750 switches and other supplies. G. M. White is manager.

DURAND, MICH.—The city of Durand expects to purchase within the next eight months lamp-posts and underground cable for an ornamental street-lighting system for the business section of the city. H. F. Rosencrans is superintendent of the municipal electric-light plant and water-works system.

HOLLAND, MICH.—Bids will be received by the Board of Public Works until Sept. 1 for furnishing and installing a vertical centrifugal pump (1100 gal. per minute) directly connected to a vertical motor. Specifications may be secured from R. B. Champion, superintendent of public works.

LANSING, MICH.—The State Railroad Commission has approved of the following bond issues, the proceeds to be used for improvements: the Grand Rapids-Muskegon Pwr. Co., of Grand Rapids, $154,000; Economy Pwr. Co. of Michigan, $115,000; Au Sable El. Co., $62,000; Commonwealth Pwr. Co., of Jackson, $130,000; Bay City Pwr. Co., of Bay City, $8,000; Saginaw Pwr. Co., of Saginaw, $34,000; Pontiac Pwr. Co., of Pontiac, $6,000; Flint El. Co., of Flint, $14,000, and Consumers' Pwr. Co., of Jackson, Mich., $12,000. The Economy Pwr. Co. of Michigan has filed application with the commission for another bond issue of $531,000. As yet no action has been taken.

COLUMBUS, OHIO.—The Board of Control has awarded contracts for the installation of cluster lamps on High Street from Warren Street to Fifth Avenue, at $13,068, to H. M. Saxbe, of Urbana and the Simonton Construction Co. Mr. Saxbe will furnish the standards and cables for the cluster lamps in State Street from Fourth to Grant Avenue, and the Avery-Loeb Electrical Co. the transformers. The cost of this work will be $3,384. Mr. Saxbe was also awarded the contract for cluster lamps on Fourth Street from Mound Street to Livingston Avenue, at $2,116.

GLOUSTER, OHIO.—Bids will be received by the Board of Public Affairs of Glouster, addressed to J. L. Davis, clerk, until Aug. 23 for equipping power plant with piping, including pump suction and discharge and machinery foundations.

HUDSON, OHIO.—The Board of Public Affairs expects to extend the distribution lines of the municipal electric-light plant and to purchase in the near future for three-wire system No. 6 and No. 8 paper-insulated, lead-covered cable, No. 8 weather-proof wire, transformers, poles, crossarms, etc.; also cast-iron water mains, valves, sewer pipe, etc., for water-works system. For further information address J. R. Wilson, superintendent of power station.

McCOMB, OHIO.—Within the next six months the managers of the municipal electric-light plant expect to purchase a 150-hp boiler and 200 meters. A. Keel is clerk.

MINGO JUNCTION, OHIO.—The power house of the plant of the United States Steel Co. here was destroyed by fire recently, causing a loss of about $15,000.

ARLINGTON, KY.—The Arlington Lumber Co. is considering the installation of an electric-light plant for the purpose of furnishing electricity to operate its sawmill. A motor-driven pump for operating water service for the mill buildings may also be installed.

CARLISLE, KY.—The Carlisle El. Lt. & Pwr. Co. is contemplating the purchase of a producer plant and gas engine of about 200 hp and would like to secure information pertaining to an electric plant operated by a producer gas engine using a directly connected generator or a belt-connected system. Boon Ingels is secretary and manager of the company.

GRAYSON, KY.—The Home Lt. Co., of Grayson, has recently installed one 50-kw direct-current Bullock generator directly connected to a 12-in. by 14-in. Ideal engine and one 100-hp Murray boiler and new switchboard.

LOUISVILLE, KY.—The National Pwr. Co., of Birmingham, Ala., is planning a hydroelectric development on the Ohio River at Louisville by the use of a new type of motor. B. M. Inman, of Birmingham, Ala., is interested in the project.

LOUISVILLE, KY.—The Board of Park Commissioners has awarded the contract for the erection and maintenance of ornamental lamp standards, each carrying one lamp, in the parks and boulevards to the Louisville Gas & El. Co.

LOUISVILLE, KY.—The Foundation Co., of Louisville, has had a bill introduced in Congress authorizing it to establish a power station of the falls of the Ohio River at Louisville, to utilize the power to generate electricity. D. Long Miller, of Louisville, is president of the company.

LOUISVILLE, KY.—The J. Schwarzwalder & Son Co., of Louisville (a cooperage concern), has announced plans for equipping its proposed new plant with electrically operated machinery. The company has a steam plant and generating equipment; it is understood that motors will be purchased in the near future. Arthur B. Herb is general manager of the company.

SEBREE, KY.—The property of the Sebree Lt. & Milling Co., consisting of flour mill, grain elevator, granary and electric-light plant, has been purchased by G. H. Warren & Sons.

CLOVERDALE, IND.—The Putnam El. Co., of Greencastle, has submitted a proposition to the Town Board offering to furnish electrical service in Cloverdale from its plant in Greencastle. The company has secured permission from the County Commissioners to erect a transmission line along the Cloverdale Pike. John G. Bryson, of Brazil, is secretary and manager of the Putnam El. Co.

HUNTINGTON, IND.—The City Council has passed an ordinance authorizing the construction of a municipal electric-light plant, to cost $75,000. The proposition to issue bonds for same will be submitted to the voters in November. H. I. Young is city clerk.

JEFFERSONVILLE, IND.—Plans and specifications have been prepared for an ornamental street-lighting system, consisting of 100 arc lamps mounted on ornamental iron posts. It has not yet been definitely decided to install the system, but bids on it will be asked in the near future, in connection with a renewal of the contract for lighting the city, which is now held by the United Gas & El. Co., of New Albany.

RICHMOND, IND.—The Richmond Lt., Ht. & Pwr. Co. contemplates making improvements to its system involving an expenditure of about $100,000.

WAYNETOWN, IND.—Arrangements are now being made for the installation of a municipal electric-light plant in Waynetown. J. W. Esterline is consulting engineer. J. J. Birdsell is president of Board of Town Trustees.

BLANDINSVILLE, ILL.—C. R. Houston, owner of the local electric-light plant, is contemplating the purchase of incandescent lamps.

CHICAGO, ILL.—Bids will be received by the city of Chicago, at Room 406 City Hall, until Aug. 20 for furnishing one 75-kw motor-generator at the water-works shops, 2304 South Ashland Avenue, Chicago, according to plans and specifications on file in the office of the Department of Public Works, Room 406. L. E. McGann is commissioner of public works.

EAU CLAIRE, WIS.—Bids will be received by the city of Eau Claire until Sept. 2 for lighting the streets with electricity; also for gas lamps. John C. Fennessey is city clerk.

WITTENBERG, WIS.—The electric plant of the Wittenberg El. Co. is reported to have been purchased by E. L. Debe, of Wausau, Wis.

CHOKIO, MINN.—The installation of an electric-lighting system in Chokio is under consideration. It is understood that energy will be secured from the Fergus Falls plant.

EDEN VALLEY, MINN.—The property and franchises, etc., of the Lethert Lt. & Pwr. Co., of Eden Valley, have been purchased by the Central Minnesota Lt. & Pwr. Co., of Glencoe, which will operate same. The Central Minnesota company has also obtained franchises in Watkins and Kimball.

HOWARD LAKE, MINN.—The Central Minnesota Lt. & Pwr. Co., of Glencoe, it is reported, contemplates the construction of a power plant in Howard Lake to furnish energy for different points on the Great Northern. W. R. Rutledge, of Howard Lake, is general manager.

JACKSON, MINN.—Bids will be received by the Village Council until Aug. 26 for the removal of the old dam across the Des Moines River and the construction of a new concrete dam and a concrete and brick power house, together with the furnishing and installation of the hydraulic and electrical equipment for a power plant with an output of 125 kw, in accordance with plans and specifications prepared by L. P. Wolff, consulting engineer, Germania Life Building, St. Paul. Plans and specifications may be seen and blank proposal form secured at the office of the consulting engineer and at the office of I. W. Mahoney, village clerk.

MANKATO, MINN.—The City Council has rejected the proposition of the Consumers' Pwr. Co., of Mankato, for municipal lighting and has decided to take immediate steps to have plans and specifications prepared for the installation of a municipal electric-light plant.

NEW ULM, MINN.—Bids will be received by the city of New Ulm at the office of the city clerk until Aug. 25 for additions to municipal electric-light plant as follows: (1) Addition and changes to brick power station; (2) radial brick or concrete stack; (3) 150-hp return tubular boiler and accessories; (4) steam engine with a rating of approximately 400 hp for direct connection to a 312-kva generator and accessories; (5) one 312-kva generator with switchboard extensions, wiring and accessories; (6) purchase by contractors of old 75-kw unit; (7) installation of shaking grate under the old boiler. Plans and specifications may be seen at the office of the city clerk at New Ulm, or at the office of the Oscar Claussen Engineering Co., Commercial Building, St. Paul. Additional copies may be secured of the engineers upon payment of $4 to cover cost of reproduction of same. Albert J. Meyer is city clerk.

WOODLAKE, MINN.—At an election held July 29 the proposition of issuing $9,900 in bonds for the installation of a municipal electric-light plant was carried. As yet no engineer has been engaged. Harry F. Payne is recorder.

ALBIA, IA.—The question of installing an electric-light plant in Albia is under consideration by the City Council.

MAXWELL, IA.—At an election held recently the proposition to grant a franchise to the Maxwell Lt. & Pwr. Co. to construct and operate an electric plant in Maxwell was carried. For further information address C. E. Lookingbill.

OTTUMWA, IA.—Plans are being considered by the public utilities committee, the Water Works Commission and the City Commissioners for the installation of a municipal electric-light plant in connection with the water-works system. The cost of installing the system is estimated at $125,000, of which $60,000 would be required for new concrete dams.

SWEA CITY, IA.—The installation of a municipal electric-light plant in Swea City is under consideration.

COLUMBIA, MO.—Plans are being prepared for the installation of an electric power plant at the University of Missouri.

GRANBY, MO.—The Ozark Pwr. & Water Co., of Ozark, has applied for a franchise to erect an electric distribution system in Granby.

ABERDEEN, S. D.—Bids will be received by George F. Fossum, architect, Aberdeen, until Aug. 20 for the construction of a three-story and basement municipal building for the city of Aberdeen. Bids on plumbing, heating, electric wiring, painting, etc., will be let separately at another date.

BRISTOL, S. D.—The Town Board has granted S. P. Waage a franchise to install an electric-light plant in Bristol.

LINDSAY, NEB.—The El. Lt. & Tel. Co., of Lindsay, expects to install storage batteries within the next 12 months and is also contemplating the installation of an alternating-current generator with motor for suburban line. Within the next six months the company expects to purchase lightning arresters, insulators and meters. The company could make use of second-hand fans and motors (must be in good condition). F. W. Edwards is manager.

POLK, NEB.—The Village Council has engaged Grant & Fulton, of Lincoln, to prepare plans and supervise the construction of an electric-light system and extensions to water-works system, for which bonds to the amount of $16,000 have been voted.

VERDON, NEB.—Charles G. Humphrey, city clerk, writes that the city does not contemplate the installation of a municipal electric-light plant as reported in the issue of Aug. 2.

WAVERLY, NEB.—Arrangements, it is reported, have been completed whereby electricity will be secured from the electric plant at Havelock to operate the proposed electric system in Waverly.

ARMA, KAN.—Albert C. Moore, of Joplin, Mo., has been engaged by the Mayor and City Council of Arma to prepare plans and specifications and to supervise the construction of the new electric-lighting plant and water-works system. The cost of the work is estimated at $40,000.

HOWARD, KAN.—Bids, it is reported, will be received by the city of Howard until Aug. 27 for an electric-light system. W. K. Palmer & Co., 919 Baltimore Avenue, Kansas City, Mo., are consulting engineers.

JUNCTION CITY, KAN.—The installation of an ornamental street-lighting system in Junction City, it is reported, is under consideration. It is proposed to contract with the Union Lt. & Pwr. Co., of Junction City, for installation of same.

KANOPOLIS, KAN.—Plans are being prepared by Henrici, Kent & Lowry, engineers, 1525 Grand Avenue, Kansas City, Mo., for the installation of an electric-light plant and water-works system at Kanapolis, to cost about $30,000.

LYNDON, KAN.—Within the next three months the managers of the municipal electric-light plant expect to purchase a one-panel switchboard (24 in. by 54 in.), one oil switch, one circuit-breaker, one transformer (2200-6600 volts) one voltmeter and one ammeter.

WILSON, KAN.—The Wilson El. Lt. Co. expects to erect within the next two months a substation for transmission line and to purchase within the next 30 days switchboard, instruments, protective devices, poles, underground conduit, meters, etc.; also an alternating-current generator (of about 50 kw) and engine, directly connected, within the next four months, and a coal conveyor and lamp-posts within the next six months.

Southern States

ALBEMARLE, N. C.—The Piedmont Pwr. Co., it is reported, contemplates the construction of a hydroelectric power plant on the Yadkin River, near Albemarle. It is proposed to develop about 18,000 hp. W. B. Lawrence, 18 Tremont Street, Boston, Mass., is engineer in charge.

GASTONIA, N. C.—It is reported that a contract has been awarded for the installation of an electric-light plant at Linwood College. A. T. Lindsay is president.

SILER CITY, N. C.—The Siler City Lt. & Tel. Co. is planning to install an oil engine and would like to receive catalogs and prices from manufacturers and dealers on 50-hp, 75-hp and 100-hp engines.

WELDON, N. C.—Bids will be received by the Town Council until Aug. 20 for construction of water-works and sewer systems, including two electrically driven centrifugal pumps and motors, capacity of each to be about 750 gal. per minute against 60-lb. pressure. Specifications, etc., may be seen at the office of the Mayor and at office of W. C. Riddick, consulting engineer, West Raleigh, N. C.

WILKESBORO, N. C.—The town commissioners have granted J. T. Humphries, of Moravian Falls, a 30-year franchise to furnish electricity to light the town.

LAKE CITY, S. C.—We are informed that the election to vote on the proposition to issue bonds for the installation of an electric-lighting system will not be held until Aug. 20. It was stated in the issue of Aug. 2 that bonds had been voted for the system.

MADISON, GA.—Within the next four months it is expected to erect 100 new poles in connection with extension to the municipal arc-lamp lighting circuit. G. W. Hubbard is superintendent.

THOMSON, GA.—The managers of the municipal electric-light plant expect to purchase within the next 60 days from 75 to 100 35-ft. to 40-ft. poles, and to purchase a 50-hp engine and a 35-kw generator within the next six months. L. J. Porter is superintendent.

TOCCOA, GA.—The Toccoa Falls Lt. & Pwr. Co. expects to install within the next 30 days an emergency steam plant at Capps Cotton Mill, using a 150-hp Corliss engine, and also to purchase one 100 kw, 2300-volt, alternating-current generator and switchboard equipment for same. E. P. Simpson is manager.

JASPER, FLA.—The local electric-light plant is reported to have been purchased by L. T. Forlaw, of Fort Pierce. It is understood that the new owner will make improvements to the system.

MELBOURNE, FLA.—E. H. Hale has been granted a franchise to install an electric-light system in Melbourne.

BRINKLEY, ARK.—The Brinkley Wtr. & Lt. Co. will change its system from direct to alternating current (2300 volts) and has purchased machinery and equipment for generating unit, excepting exciter, and will have to purchase one 25-hp, 110-volt, 60-cycle, three-phase motor for centrifugal pump. The company also expects to purchase within the next few months one switchboard complete (about three panels) for alternating current generator, 12 or 15 transformers, for primary circuit 3 or 4 miles, cross-arms and glass insulators for same and one tub transformer for a series tungsten lamp street-lighting system. J. W. Neff is superintendent.

DANVILLE, ARK.—The Danville El. Co. expects to purchase within the next 30 days a boiler (from 90 hp to 100 hp) and to install same within the next two months. C. T. Meadows is superintendent.

MORRILLTOWN, ARK.—S. R. and M. D. Morgan, owners of the Eldorado electric-light plant, are reported to have taken charge of the local electric-light system and will make extensions and improvements to same.

MARIETTA, OKLA.—The City Council has engaged the Bonham Engineering Co., 435 American National Bank Building, Oklahoma City, to prepare plans and specifications for extensions to the electric-light plant, water-works system and sewers. The proposition to issue bonds for the proposed work will be submitted to the voters.

CORPUS CHRISTI, TEX.—A 200-kw direct-current General Electric generator directly connected to a right-hand tandem compound Harrisburg engine is being installed in the Earl C. Heinly power and light plant. Within the next three months it is expected to purchase 50 arc lamps for use on 550-575-volt direct-current circuit. V. S. Heinly is secretary.

DALLAS, TEX.—The Board of Municipal Commissioners will receive bids until Aug. 20 for the mechanical equipment and installation of same in the new municipal building. The apparatus includes the heating and ventilating equipment, with fans and pumps, plumbing and gas fitting, with hot and cold water and necessary pumps, cleaning system with four sweeper attachments, electrical wiring and appliances and elevators for passenger service and for sidewalk lift.

PORT ARTHUR, TEX.—Plans are being considered by the business men for the installation of ornamental lamps on Austin Avenue from Proctor Street to Sixth Street.

RUNGE, TEX.—At an election to be held Aug. 27 the proposition to issue $20,000 in bonds for the installation of an electric-light plant and water-works system will be submitted to the voters.

VAN HORN, TEX.—The commissioners of Culberson County have purchased the electric light and power plant and water-works system of the Van Horn Lt. & Wtr. Co. for $10,000. It is understood that the plants will be enlarged and other improvements made to the service.

VENUS, TEX.—The Venus Lt. & Wtr. Co. has recently installed a new engine for day load. A. D. Frost is manager.

Pacific States

CASHMERE, WASH.—The power site owned by O. M. Carter and associates on the Wenatchee River was recently purchased by O. B. Hollis and M. M. Dickson, both of Spokane, who, it is said, propose to build a hydroelectric power plant to develop 1600 hp.

METALINE FALLS, WASH.—The Department of the Interior has granted the International Pwr. & Development Co. a permit to erect a large hydroelectric power project on the Pend Oreille River near Metaline Falls. The proposed plant will have an ultimate output of 350,000 hp and will cost when completed about $5,000,000. Wilbur S. Yearsley, of Spokane, is president of the company.

PALOUSE, WASH.—Several important transmission line extensions will be erected out of this city by the Washington Wtr. Pwr. Co., of Spokane.

SPOKANE, WASH.—The property owners on the Main and Trent Avenues districts have petitioned the city commissioners for a street-lighting system, the same to be installed between Lincoln and Division Streets.

CLATSKANIE, ORE.—The local electric-light plant has recently changed hands. The new owners, it is understood, will enlarge and improve the plant. An addition will be built to the power house and concrete foundations put in for new machinery, which, it is said, will double the output of the plant. Contract has already been placed for the waterwheel. W. W. Seymour, Mayor-elect of Tacoma, Wash., is president of the company.

HEPPNER, ORE.—Plans are being considered by the Heppner Lt. & Wtr. Co. for enlarging its power plant and establishing a day service. The present plans provide for doubling the output of the plant, rebuilding the distribution system and replacing the present arc-lamp street-lighting system with incandescent lamps. The cost of the improvements is estimated at $20,000.

MARSHFIELD, ORE.—The Oregon Pwr. Co., which recently took over the electric franchises in Coquille and Myrtle Point, is planning to erect a large central power plant in Marshfield to furnish energy to North Bend, Marshfield, Eastside, Coquille, Myrtle Point and other towns in the county. A high-tension transmission line, now under construction, will be used jointly by the Oregon Pwr. Co. and the C. A. Smith Co., the latter transmitting energy to its logging camps. At present the Oregon Pwr. Co. is purchasing the surplus energy from the plant of the Smith Lumber Co. and distributing same among local consumers.

PORTLAND, ORE.—The proposition to purchase the lighting system which serves the Laurelhurst district and improve same is under consideration by Mayor Albree and the city commissioners. The city commissioners also contemplate the installation of cluster lamps in the Laurelhurst district.

LOS ANGELES, CAL.—The State Railroad Commission has authorized the Pacific Lt. & Pwr. Co. to issue $2,500,000 in capital stock to be sold at not less than $80 per share, the proceeds to be used for the completion of its hydroelectric development at Big Creek in Fresno County.

SACRAMENTO, CAL.—The North Sacramento Land Co. has made arrangements with the Great Western Pwr. Co. whereby the latter will extend its distribution lines 2 miles or more to furnish energy for lamps and motors in the suburb of North Sacramento.

SAN DIEGO, CAL.—The Los Angeles & San Diego Beach Ry. Co. is contemplating the construction of a power plant near Pacific Beach.

SUTTER CREEK, CAL.—The Board of Trustees has accepted the bid of the Amador El. Lt. & Pwr. Co., of Sutter Creek, for lighting the streets of the city, and it is expected that work will soon begin on installation of the system. The plans provide for lighting not only the principal thoroughfares but the alleys and streets throughout the town.

TWIN FALLS, IDAHO.—All bids submitted Aug. 4 for installing a cluster street-lighting system in lighting district No. 17 were rejected. New bids will probably be received later. Stuart H. Taylor is city clerk.

BINGHAM, UTAH.—The transformer station and the compressor plant of the Utah Copper Co. was recently destroyed by fire, causing a loss of about $100,000.

GREAT FALLS, MONT.—The City Council recently formed a lighting district which provides for the installation of cluster lamps on Second Avenue immediately.

HOLLY, COL.—The Water and Light Commission will install within the next 30 days one 50-kw, 60-cycle, 2300-volt alternator and a new power panel to switchboard in the municipal electric light and water plant.

Canada

NEEPAWA, MAN.—The town of Neepawa will call for tenders in the near future for equipment for an electric plant, consisting of two 150-hp boilers and generating unit, consisting of a 125-kw generator directly connected to suitable engine. Plans and specifications are now being prepared by W. E. Skinner, Ltd., 204 Sterling Bank Building, Winnipeg, Man.

AURORA, ONT.—At an election held Aug. 4 the ratepayers voted in favor of the by-law appropriating $16,000 for the purchase of electrical machinery for the municipal electric-light system, also a by-law providing $5,000 for the purchase of electrically operated pumps. Steps will be taken at once to install the machinery and increase the number of street lamps from 60 to about 300.

FORT WILLIAM, ONT.—The proposed development of the Kaministiquia Pwr. Co., of Fort William, at Kakabeka Falls, is to be 15,000 hp instead of 15,000,000 hp as stated (owing to a typographical error) in the issue of Aug. 9.

WELLAND, ONT.—The Electric Sheet & Metals Co., Ltd., is reported to have secured property in Welland on which it will erect an iron and steel plant (melting iron and steel by electricity). It is also stated that the company has contracted for electrical energy to the amount of several thousand horse-power to operate its plant.

CHARLOTTETOWN, P. E. I.—The Charlottetown Lt. & Pwr. Co. is making improvements to its plant, including the installation of a second gas producer and engine and other apparatus, also changing its system from 133 cycles to 60 cycles. Upon completion of the plant a day service will be established.

MONTAGUE, P. E. I.—The Montague El. Co. expects to build within the next three months a dam with concrete flume. N. J. McDonald is secretary.

COOKSHIRE, QUE.—The Westbury El. Lt. & Pwr. Co., of Cookshire, expects to erect within the next few months about 8 miles of transmission lines and to purchase a 200-kw alternating-current generator, waterwheel governor and 100 watt-hour meters. H. A. Worby is manager.

New Incorporations

TAMPA, FLA.—The American Utilities Co. has been incorporated with a capital stock of $100,000 to construct and operate water-works, electric-light systems, etc. The officers are: James F. Taylor, president; J. J. Logan, vice-president, and Charles H. Davis, secretary and treasurer.

COLUMBUS, GA.—The Muscogee Lt. & Pwr. Co. has been incorporated by Edward W. Swift, J. P. Illges, J. P. Kyle, Clifford J. Swift, John T. Davis, Jr., T. E. Golden and others. The company is capitalized at $50,000 and proposes to generate and distribute electricity for lamps and motors.

BRIDGEWATER, PA.—The Bridgewater El. Co. has been granted a charter with a capital stock of $5,000.

HARRISBURG, PA.—Articles of consolidation have been filed at the State Department by 22 electric light and power companies organized to do business throughout Beaver and Lawrence Counties under the name of the United Pwr. & Lt. Co. The new company is capitalized at $110,000. The officers are: George R. Barnett, president; E. E. Barnitz, secretary, and George Heard, treasurer, all of Harrisburg.

RED LION, PA.—The Laurel El. Lt. & Pwr. Co. has been organized with a capital stock of $10,000 for the purpose of furnishing electrical service in the township of East Hopewell. The directors are: Benjamin F. Roseman, of Red Lion, treasurer; Samuel Roseman, of Red Lion, and Charles A. Shaull, of Laurel. The office of the company will be located in Red Lion.

MADISONVILLE, TEX.—The Madisonville Lt. & Pwr. Co. has been incorporated with a capital stock of $6,500 by A. A. Allen, A. E. Page and F. E. White.

BARNET, VT.—The McIndoe Falls Lt. & Pwr. Co. has been incorporated with a capital stock of $4,000 by J. M. Gibson, Clara B. Gibson, D. L. Judkins and L. E. Judkins. The company proposes to furnish energy at Barnet and Ryegate, Vt., and Monroe, N. H. It already has a plant in Barnet and will extend its transmission lines.

WINNIPEG, MAN., CAN.—The Commercial Pwr., Lt. & Coal Co. has been incorporated with a capital stock of $250,000 by F. M. Burbridge, R. C. McPherson and R. W. Killey.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 5, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,069,095. DYNAMO ELECTRICAL MACHINE; D. H. Andrews, Newton, and E. C. Ketchum, Boston, Mass. App. filed Jan. 17, 1912. Film of mercury is prevented from bridging across between adjoining contact disks of the armature by tapered insulating ridges standing out from the periphery of the armature disks.

1,069,113. NON-CORROSIVE METALLIC ALLOY; John Coup, Marion, Ohio. App. filed April 1, 1913. A substitute for nickel plating and used in piano strings, bells, etc., where it is essential that it be non-corrosive to preserve the tone; consists of copper, nickel, zinc, aluminum, phosphor-tin, lead and iron.

1,069,121. PROCESS OF HEATING WATER; R. R. Foster, Colton, Cal. App. filed July 30, 1912. Heat is radiated downward directly onto an exposed thin layer of water.

1,069,125. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed June 25, 1909. Push-button switch operated by door bolt to insure lights being turned off when apartment is vacated, as in hotels, etc.

1,069,126. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed June 28, 1911. Push-button type; racks on the push buttons mesh with a pinion on the switch spindle.

1,069,151. PROCESS FOR THE PRODUCTION OF AN INSULATING COATING ON ELECTRICAL CONDUCTORS; J. Loewenthal, Berlin, Germany. App. filed Dec. 6, 1912. Strongly adhering aluminum compounds from a suitable solution of aluminum salts are electrolytically precipitated on the conductor while the conductor is used as a cathode.

1,069,165. RAILWAY SAFETY APPARATUS; J. D. Nix, Ferriday, La. App. filed March 16, 1910. Third-rail contact system with solenoid valve controlling throttle, brakes and signal.

1,069,169. SEPARATING APPARATUS; H. Parker, Nashua, N. H. App. filed Feb. 28, 1911. Separates the solid matter in suspension in the waste water from a paper-making or like machine by liberating in the fluid a large amount of gas from an electrolytic gas-producing chamber, the gas bubbles attaching themselves to the solid matter and carrying it to the surface.

1,069,178. PROCESS OF RECOVERING ZINC; C. J. Reed, Philadelphia, Pa. App. filed June 3, 1912. Treats zinc-containing material with an excess of sulphuric acid, treats resulting solution with an oxidizing agent, purifies the oxidized solution with an excess of zinc-containing substance, further purifies with metallic zinc and finally recovers the zinc from the purified solution.

1,069,179. PROCESS OF ROASTING ORES AND RECOVERING ZINC THEREFROM; C. J. Reed, Philadelphia, Pa. App. filed June 3, 1912. Reduces metallic sulphide to fine powder, mixes powder with material containing a metallic oxide and subjects mixture to heat in presence of an oxygen-containing fluid.

1,069,187. METHOD OF AND MEANS FOR MEASURING POWER IN ELECTRIC CIRCUITS; H. J. Ryan, Palo Alto, Cal. App. filed Nov. 8, 1910. For measuring small power consumptions in alternating-current circuits of high voltage; produces an inclosed curve or diagram by means of a pencil of cathode rays displaced simultaneously in two directions at right angles.

1,069,197. MACHINE FOR ELECTRICALLY WELDING WIRE FABRICS; H. L. Smith, Clinton, Mass. App. filed Sept. 18, 1907. Stationary welding jaw and complemental welding jaw in the form of a heavy copper block having a curved seat or recess and flexibly connected with a transformer.

1,069,208. TROLLEY; S. F. Walker, Bozeman, and A. W. Walton, Butte, Mont. App. filed June 9, 1909. Upward pull on trolley rope when trolley leaves the wire throws the finder fingers up into operative position.

1,069,211. ELECTROLYTIC METER; E. Weintraub, Lynn, Mass. App. filed Feb. 14, 1910. Has a mercury anode and an osmotic membrane of goldbeater's skin separating the anode from the electrolyte, which contains potassium sulphocyanate.

1,069,252. ELECTRIC FURNACE; A. Helfenstein, Vienna, Austria-Hungary. App. filed June 5, 1912. Transformer is placed on the outside of and beneath the revolubly mounted tubular metal container and the secondary has brushes engaging with flanges on the container.

1,069,255. GLASS FURNACE AND PROCESS; P. L. T. Heroult, La Praz, France. App. filed Aug. 26, 1910. Treats liquid glass in an electric furnace with a current between electrodes consisting of pools of molten metal electro-negative to the metals of the glass.

1,069,259. TRANSFORMER; S. E. Johannesen, Pittsburgh, Pa. App. filed March 3, 1906. Magnetizable core is supported by frames, and ventilating passages are provided between the coils, between the core and the coils and between the frames and the core.

1,069,260. METALLURGICAL APPARATUS; W. McA. Johnson, Hartford, Conn. App. filed Sept. 20, 1909. For condensing vapors of zinc such as those obtained from a gas or electric furnace.

1,069,291. ELECTROMAGNETIC MOTOR; H. A. Rhodes, Denver, Col. App. filed Sept. 13, 1909. Series of electromagnets arranged in circular form and concentric rotatable armature having magnetic segments spaced by non-magnetic members.

1,069,305. PROCESS OF ELECTROLYTICALLY REFINING COPPER; G. D. Van Arsdale, East Orange, N. J. App. filed Oct. 2, 1908. Separates copper by electrolysis from an electrolyte containing copper in the cuprous state.

1,069,307. TELEPHONE RECEIVER HOLDER; A. Wetzel, Los Angeles, Cal. App. filed June 29, 1912. Wall bracket in which the receiver is placed when taken off the hook.

1,069,310. LIGHTNING ARRESTER; A. J. Wurts, Pittsburgh, Pa. App. filed Aug. 2, 1905. Horn-gap type; horns are of greater resistance toward their outer ends so as to introduce resistance in series with the arc.

1,069,326. SMELTING FURNACE; O. S. Emberg and O. J. D. Emberg, Chicago, Ill. App. filed Aug. 8, 1912. Has sectional jointed electrodes.

1,069,331. SWITCHING DEVICE; F. W. Harris, Wilkinsburg, Pa. App. filed Oct. 7, 1908. No-voltage knife-switch circuit-breaker; a voltage magnet coil operates a toggle which acts in opposition to the switch-opening spring.

1,069,347. SELECTIVE SIGNALING SYSTEM; A. C. Reid, Genoa, Ill. App. filed May 4, 1909. Step-by-step selectors at substations and a sluggishly moving circuit-closing element interposed between the step-by-step element and a signal.

1,069,371. METHOD AND APPARATUS FOR HEATING; G. G. Bell, London, and J. St. V. Pletts, Teddington, England. App. filed Sept. 25, 1909. Heats an iron accumulator with small quantity of electric energy and draws off the water to be heated through the center of the heated mass.

1,069,372. APPARATUS FOR HEATING WATER AND OTHER LIQUIDS OR FLUIDS; G. G. Bell, London, England. App. filed Dec. 17, 1910. Heat-storage mass surrounded by an external annular water chamber.

1,069,373. ELECTRIC HEAT CONSERVING, HEATING AND COOKING APPARATUS; G. G. Bell, London, England. App. filed Jan. 9, 1911. Has a hollow-iron heat accumulator forming an oven.

1,069,375. HEAT-STORAGE DEVICE FOR HEATING WATER OR OTHER LIQUIDS; G. G. Bell, London, England. App. filed Nov. 7, 1911. Heat-storage mass with water channels therethrough provided with removable stoppers to permit cleaning.

1,069,376. COOKING APPARATUS; G. G. Bell, London, England. App. filed Nov. 7, 1911. Heat-storage mass with a deflected air passage therethrough and an oven connected to the heated air passage by supply and return ducts.

1,069,377. APPARATUS FOR COOKING AND FOR CARRYING OUT LIKE OPERATIONS BY MEANS OF ELECTRICITY; G. G. Bell, London, England. App. filed Nov. 7, 1911. Has a common electrical heating element for both the air heater and the water heater and steam generator.

1,069,378. METHOD AND APPARATUS FOR HEATING; G. G. Bell, London, and J. St. V. Pletts, Teddington, England. App. filed Sept. 25, 1909. A heat accumulator heats to a high degree a relatively small body of water and to a lower degree a larger body of water, and the two bodies are mixed as they are drawn off to gain the desired heat.

1,069,401. ELECTRICAL APPARATUS; S. M. Esler, McHenry, Ill. App. filed June 9, 1910. For shifting arrangements at consumer's station from the central station to operate consumer's meter at different rates or percentages; magnet with differential armatures to operate a ratchet.

1,069,425. ELECTRIC SWITCH BOX; L. B. Hornbeck, Minneapolis, Minn. App. filed Nov. 14, 1910. The switch box has a flanged telescoping section adjustable in and out according to the thickness of the plaster.

1,069,434. COMBINED TRIP AND THROTTLE VALVE; P. W. Knauf, Cynwyd, Pa. App. filed May 14, 1912. Ordinarily operated through nut and screw, but may be tripped by electromagnet to close automatically.

1,069,440. DOMESTIC COOKER; J. Lawrence, New York, N. Y. App. filed Dec. 16, 1909. Cooking chamber surrounded by a metal mass of large heat-storage capacity.

1,069,441. OVEN; J. Lawrence, London, England. App. filed Nov. 9, 1911. Oven has an inner wall of refractory material and a surrounding wall of heat-storage material with an intervening air space.

1,069,458. TELEPHONE LOCKING SYSTEM; W. A. Morse, North Grosvenor Dale, Conn. App. filed Jan. 7, 1913. Subscriber on calling central automatically locks out all other telephones on the line.

1,069,472. SYSTEM OF ELECTRIC MOTOR CONTROL; C. Renshaw, Edgewood Park, Pa. App. filed Nov. 24, 1911. Time-limit relay switch for effecting the gradual acceleration of the motor.

1,069,493. CHEMICAL GENERATOR OF ELECTRICITY; O. Lozzi, Naples, Italy. App. filed Sept. 9, 1912. Cell of Daniells type.

1,069,518. SWITCH; W. J. Barrett, Richmond, Va. App. filed Sept. 10, 1912. Incased knife switch with a projecting operating handle adapted to lock in notches in the casing.

1,069,519. TROLLEY; S. A. Bemis (deceased; E. M. Bemis, executrix, Springfield, Mass.). App. filed Oct. 12, 1910. Trolley head has a hinged jaw permitting removal of the trolley without removing the axle stud.

1,069,531. ELECTRIC SWITCH; L. G. Copeman, Flint, Mich. App. filed Dec. 23, 1911. Knife switch set in patch of actuating member and provided with a spring so that a slight movement will cause it to snap closed.

1,069,535. FAC-SIMILE TELEGRAPH; F. De Bernochi, Turin, Italy. App. filed March 23, 1911. Wireless transmission of pictures, writings, etc.

1,069,601. FURNACE; J. Churchward, Mount Vernon, N. Y. App. filed April 26, 1911. Furnace rotating on a vertical axis and electrodes projecting into the furnace. Furnace has converging walls forming an inclined discharging trough (fifty claims).

1,096,610. CIRCUIT-CHANGING DEVICE; W. H. Gaulke, Milwaukee, Wis. App. filed Sept. 26, 1911. Multiple step-by-step switch for starting purposes, etc.

1,069,627. ELECTRIC SIGN; A. C. Meyer, San Diego, Cal. App. filed Feb. 7, 1912. Motor-driven flasher mechanism.

1,069,635. ELECTRIC BOX CONNECTION; Frederick H. Ward, Brooklyn, N. Y. App. filed June 6, 1911. Ends of the conduits secured to the box by clamps which bind the conduits against the interior walls of the entrant portions of the box.

1,069,661. SWITCH; V. H. Carman, Indianapolis, Ind. App. filed Dec. 11, 1912. Plural-bladed switch with progressively engaging contacts for starting three-phase induction motors, etc.